مجلة جمعية المهندسين المصرية

٢٨ شــارع رمسيس ــ القاهرة ج ٠ م ٠ ع ٠ ت ت : ٧٤٠٤٨٨/٧٤٠٥٦٩

المجلد السابع والعشرين — **العدد الأول ١٩٨٨**

- تصدر المجلة ربع سنوية .
- ترسل النصوص المطلوب موافقة هيئة التحرير على نشرها باسم السيد/ رئيس التحرير . وهو غير مسئول عن فقد أو تلف أى نص .
- تنشر المجلة المقالات التى تسهم فى رفع مستوى العلوم الهندسية وطرق ممارستها .
- تقبل للنشر المقالات باحدى اللغتين العربية أو الانجليزية على الآلة الكاتبة ومعها ملخص بكل من اللغتين .
- المجلة غير مسئولة عن الآراء والمحتويات التى تنشر وهى تعبر عن كاتبها فقط .
- تذكر أسماء أصحاب المقالة كاملة باللغتين ومعها القابهم العلمية ووظائفهم .
- يراعى الا تتجاوز المقالة ٨ صفحات بالمجلة ، وفى سبيل ذلك يختصر الاشتقاق الرياضي ويستعاض عن الجداول بمنحنيات مرسومة بالحبر الشينى الأسود ، على أن يشغل المنحنى نصف صفحة على الأكثر ولا يشـغل صفحة كاملة الا فى حالات استثنائيـة وسيصغر أى منحنى الى تلك المقاسات .
  ويراعى الا يقل ارتفاع الحـروف او الأرقام علـى المنحنيات المنشورة عن ٣ مم بعد التصغير .
- يعنى بذكر المراجع المستقى منها المقـال وتصنف تبعا لاسم المؤلف ثم العنوان ثم المجلة أو الكتاب وتاريخه .

اشتراكات المجلة :

يتلقى اعضاء الجمعية نسخهم مجانا .

ولغير الأعضـاء :

الاشتراك السنوى للمهندسين	٢٠ جنيها
الاشتراك السنوى لغير المهندسين	٥٠ جنيها
الاشتراك السنوى للهيئات	٥٠٠ جنيها

وخارج مصر :

للأفراد ٧٥ دولار امريكى سنويا .

وللهيئات ٥٠٠ دولار امريكى سنويا .

وذلك عن الأربع اعداد السنوية ويعامل العدد الواحد بواقع الربع من هذه القيمة .

وتعطى أولوية النشر بالمجلة للسـادة الزملاء اعضـاء جمعية المهندسين المصرية .

رقم الايداع بدار الكتب ٢٩٨

طبعت بمطابع دار الشعب

محتويات العدد

التشييد والبناء

القسم العربى :

* * *

القسم الافرنجى :

التصنيع والانتاج

القسم العربى :

* * *

القسم الافرنجى :

الخامات الأولية والصناعات الكيميائية

القسم العربى :

* * *

القسم الافرنجى :

التشييد والبناء

جمعية المهندسين المدنيين
جمعية المهندسين المعماريين
جمعية مهندسى الرى

الورش الصناعية

د. رؤوف مصطفى حلمى
د. ماهر شوقى

اولا ـ مشروع نقل ورش الصيانة وورش الصناعات الخفيفة من منطقة وسط القاهرة

د. روءف مصطفى حلمى

يسبب تواجد كل من ورش الاصلاح والصيانة من جانب وورش الصناعات الصغيرة من جانب آخر فى منطقة وسط مدينة القاهرة ، والتى تعانى من اختناق حركة المرور ونقص أماكن انتظار السيارات علاوة على الضوضاء وتلوث البيئة ، ـ مشكلة هامة وعاجلة من الواجب مواجهتها بسرعة وحسم ، لايجاد حل واقعى مدروس لنقلها خارج منطقة وسط المدينة الى مناطق جديدة ومناسبة خارج وعلى حدود الكتلة العمرانية للمدينة حتى تستطيع أن تؤدى وظيفتها بفاعلية ولرفع كفاءة أداء منطقة وسط القاهرة كمنطقة حيوية ومركزا حضاريا للعاصمة.

وتنحصر مشكلة تواجد الورش بمنطقة وسط المدنية فى نوعين من الاشغالات :

١ ـ ورش الاصلاح والصيانة وتتركز بصورة واضحة فى ورش اصلاح السيارات .

٢ ـ ورش الصناعات الصغيرة والحرفية والممتدة داخل المنطقة السكنية .

وقد عملت دراسة ميدانية بمنطقة وسط القاهرة فى مساحة قدرها كيلومتر مربع واحد لتحديد حجم المشكلة . وتمتد هذه المنطقة شمالا من ميدان عبد المنعم رياض وغربا منطقة ميدان التحرير وجنوبا حتى حدود ميدان الجمهورية .

وتعتبر هذه المنطقة قلب وسط المدينة حيث يقع بها أهم الشوارع التجارية ومنطقة الأعمال بالقاهرة علاوة على تركيز الخدمات الثقافية والترفيهية ... حيث تتركز كافة هذه الأنشطة كل من شوارع طلعت حرب ـ قصر النيل ـ شريف ـ عدلى ـ عبد الخالق ثروت ـ محمد فريد ـ شامبليون ـ محمود بسيونى ـ البستان ـ التحرير والتى تعتبر محاور أساسية للانشطة التجارية والادارية .. وكما يدخل ضمن منطقة الدراسة كل من ميدان طلعت حرب ـ ميدان التحرير ـ ميدان الفلكى .

ومن خلال دراسة هذه المنطقة وجد تركيز شديد من ورش صيانة السيارات ومحلات قطع الغيار وورش الصناعات الحرفية الصغيرة .

وقد اوضحت الدراسة حجم هذه الأنشطة كالآتى :

ـ ورش صيانة سيارات عدد ١٩٢ ورشة .
ـ محلات بيع قطع الغيار عدد ١٠٦ محل .
ـ ورش صناعات خفيفة عدد ٦٣ ورشة .

وقد اشتملت ورش صيانة السيارات بهذه المنطقة على النوعيات التالية :

ورش ميكانيكية ـ ورش كهربائية ـ ورش لاصلاح الاطارات ـ ورش دهان بالدكو ـ ورش سمكرة ـ ورش سروجى ـ ورش خراطة ـ ورش لحام اكسوجين ـ ورش زجاج سيارات .

واشتملت ورش الصناعات الحرفية على النوعيات التالية :

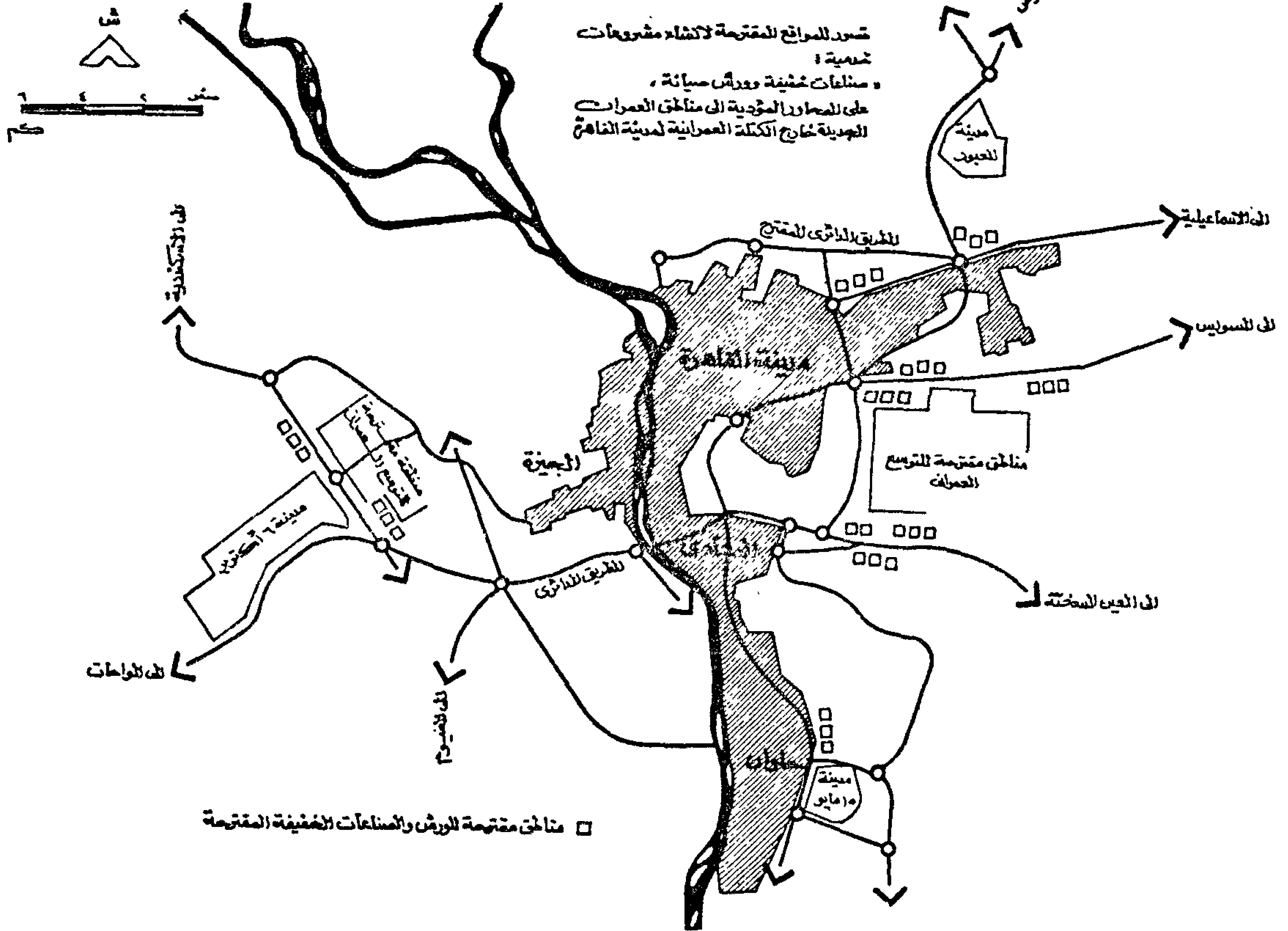
ورش تجليد وطباعة ـ أحذية ـ نجارة ـ خراطة ـ بوتاجاز ـ ثلاجات ـ حدايد ـ وبويات ادوات صحية ـ كهرباء .

وقد اتضح من هذه الدراسة أن المنطقة الواقعة حولى محورى شارع شامبليون وشارع معروف والمحددة بكل من شارع رمسيس شمالا وعبد الخالق ثروت شرقا وطلعت حرب جنوبا ومحمود بسيونى غربا منطقة عالية التركيز من حيث ورش صيانة السيارات .

كما اتضح اشغال الورش الصناعية للأدوار الأرضية والأولى للمبانى السكنية مما يعرض السكان والعاملين بهذه الورش لخطر الحرائق علاوة على الضوضاء وتلوث الهواء واختناق المرور .

وقد أوصت الدراسة التى تمت على منطقة محدودة داخل منطقة وسط المدينة على عمل دراسة تفصيلية شاملة على كل من منطقة وسط المدينة بأكملها لحصر هذه الأنشطة وتسجيلها ومعرفة حجمها .. على ان تمتد هذه الدراسة لحصر الأنشطة على مستوى أحياء مدينة القاهرة ووضع تصور واقعى لامكانية نقل بعضها الى مناطق التوسع الجديدة على أن يتم اشراك خبراء اقتصاديين واجتماعيين وقانونيين لتغطية كافة مجالات المشكلة .

كما اوصت بتحديد أماكن انتقال هذه الانشطة خارج قلب القاهرة حتى يمكن لها القيام بوظيفتها بنجاح .



ثانيا ـ تحديد المعدلات اللازمة للورش الصناعية الصغيرة بالمجتمعات الجديدة

د. ماهر شوقى

ـ تحتاج تخطيط المجتمعات الجديدة الى معايير واسس ومعدلات للورش الصغيرة ، ولاشك ان تخطيط هذه المعدلات على أساس من الواقع الحالى بعد تطويره ، لذلك تم عمل دراسة فى هذا المجال فى مدينة أسيوط .

ـ وعلى ضوء ما اظهرته نتائج هذه الدراسة أمكن تحديد تصور لمتطلبات الورش فى المجتمعات الجديدة ـ وامكن تحديد المعدلات اللازمة لها على أساس تجميع الورش على مستويين .

١ ـ مستوى تجمع سكانى حجمه ٥٠ ـ خمسون الف نسمة .

٢ ـ مستوى تجمع سكانى حجمه ٢٠٠ مئتان الف نسمة .

ـ وقد تحدد اجمالى عدد الورش ومساحتها المبنية فى كل مستوى على اساس نوع الورشة وعدد الوحدات النمطية لكل ورشة والوحدة النمطية ٣٦ متر ومضاعفاتها .

ـ وقد روعى ان يكون اجمالى مساحة مواقع الورش على أساس أن تكون المساحة المبنية تشغل نصف مساحة الأرض .

ويوضح الجدول الآتى عدد الورش وعدد الوحدات النمطية اللازمة ومساحة الورش الصافية والكلية حسب نوع الورشة فى كل مستوى من المستويين (٥٠ ، ٢٠٠ الف نسمة).

مكانيكى — سيارات (٩) — تشغيل أخشاب (٢٠) — حدايد (١٤) — تمام معادن اكسجين (٩) — مستودعات — خراطة معادن (١٣) — حديد (١٠) — كهرباء سيارات (٧) — دوكو (١)

معدل الورش المقترحة فى المجتمعات الجديدة لكل ٢٠٠,٠٠٠ نسمة

مكانيكى — سيارات (٨) — تشغيل أخشاب (١٣) — كهربائى سيارات (٥) — خراطة — معادن (٧) — تمام معادن اوكسجين (٦) — دهان دوكو (٣) — حدايد (٨) — (١٠)

معدل الورش المقترحة فى المجتمعات الجديدة لكل ٥٠,٠٠٠ نسمة

معدل الورش المقترحة فى المجتمعات الجديدة

نوع الورشة	عدد الوحدات الفعلية	٥٠,٠٠٠ نسمة		٢٠٠,٠٠٠ نسمة	
		عدد الورش	مساحة الورش (م٢)	عدد الورش	مساحة الورش (م٢)
تشغيل أخشاب	٣	١٣	١٤٠٤	٢٠	٢١٦٠
كهرباء سيارات	١	٥	١٨	٧	٢٥٢
دهان دوكو - بيع بويات لحام كاوتشوك	٢	٣	٢١٦	١	٧٢
ميكانيكى سيارات	٢	٨	٥٧٦	٩	٦٤٨
لحام معادن والسجين	١	٦	٢١٦	٩	٣٢٤
خراطة معادن	٢	٧	٥٠٤	١٣	٩٣٦
الحدادة "حدايد"	٢	٨	٥٧٦	١٤	١٠٠٨
مستودعات حديد - ورش برادة - سمكرى - تشكيل معادن	١	١٠	٣٦٠	١	٣٦٠
إجمالى المساحة المبنية للورش		٦٠	٤٠٣٢	٨٣	٥٧٦٠
إجمالى مساحة مواقع الورش		٦٠	٨٠٦٤	٨٣	١١٥٢٠

الطبيعة وتخطيط المدن

محمد محمد البرملجى

الطبيعة بعناصرها الجذابة والجميلة من العوامل الرئيسية الهامة والتى لا يمكن للانسان أو المخطط أو المصمم تجاهلها . ومما لا شك فيه باننا جميعا مقتنعون ان حالة البيئة الطبيعية التى يعيش فيها الانسان تؤثر تأثيرا قويا وواضحا على درجة استمتاعه بالحياة .

ولذا يتعين على المختصين فى جميع المجالات والمخطط والمصمم ان يركزوا جهودهم ومهارتهم التخصصية والعلمية والتطبيقية فى محاولة لتهيئة البيئة الطبيعية وخلق تجانس تام بين الطبيعة واحتياجات الانسان كهدف قومى اساسى سواء كان المقياس الاقليم أو المدينة أو القرية او المجموعات السكنية الصغيرة .

والطبيعة تتحدى المخطط والمصمم تحد صارخ وواضح بأشكالها القوية وعناصرها الجذابة والخلابة وقواها المحيطة التى تؤثر فينا تأثيرا قويا لا يمكن تجاهله ولكى يستطيع التغلب على هذا التحدى يجب علينا ان نتفهم الطبيعة حتى يمكننا الاستفادة من أشكالها والتنسيق التام بينها وبين الاشكال والعناصر التى يحتاجها ويفرضها الانسان عليها .

وكذا تحديد عناصر الطبيعة وملامحها وتفاصيلها والمحافظة عليها وتأكيدها بوضع العناصر التصميمية والتخطيطية التى من صنعنا حولها فى تجانس تام معها ولتخفيف الضغط على المدن الرئيسية بجمهورية مصر العربية والمدينة الأم القاهرة .

ولتخفيف الضغط عن المدن الرئيسية بجمهورية مصر العرتية والمدينة الام القاهرة الكبرى .

بدات الدولة فى تخطيط مدن جديدة بالصحراء لامتصاص الانفجار السكانى بالقاهرة الكبرى ويتعين علينا دراسة محددات البيئة والطبيعة وتأثيرها على تخطيط هذه المدن وتتلخص هذه الدراسات فيما يلى :

أولا ــ تأثير الطبيعة على عناصر البنية الرئيسية للمدينة :

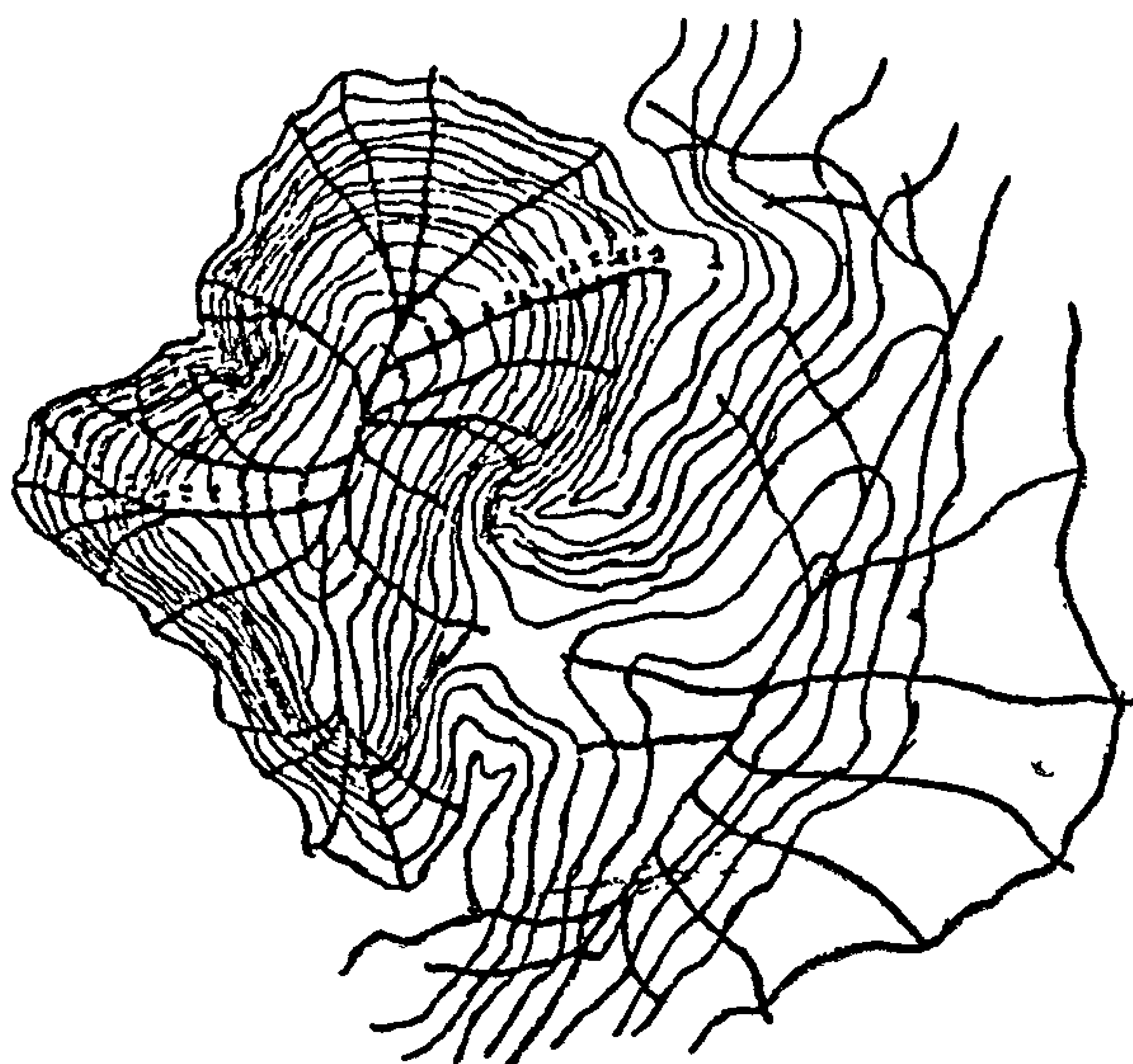
وتؤثر الطبيعة على عناصر البنية الرئيسية للمدينة وتخطيطها الأمثل وتفرض على المخطط بدائل تصميم ويتعين على المخطط ان يختار أفضلها انسجاما وتنسيقا مع الطبيعة ومن عناصر البنية الرئيسية .

(أ) خطوط الحركة الرئيسية والثانوية :

وتشمل الطرق والمسارات المكونة للمدينة ــ ومن أهم العناصر الطبيعية التى تؤثر على تخطيط الهيكل العام للطرق بالمدينة طبوغرافية كما يلى :

١ ــ تأثير خطوط القمم :

وهى الخطوط التى تصل نقطة القمة ببعضها مكونة سلاسل الجبال وبدراسة طبوغرافية الموقع لأى منطقة طبيعية يراد تخطيطها تجد المئات والآلاف من هذه الخطوط والسلاسل منتشرة من أعلى نقطة القمة فى الموقع فى اتجاهات مختلفة وتشمل هذه الخطوط مسارات الحركة من قمم الجبال خلال سلاسلها الى أسفل للوصول الى مناطق القيعان ومن الطبيعى أن يختلف كل خط من خطوط القمم فى خصائصه من حيث الطول والميل طبقا لطبوغرافية الموقع (شكل رقم ١) .



شكل رقم (١) خطوط القمم
Ridge Line

** استاذ مساعد / تخطيط مدن ــ كلية الهندسة ــ جامعة القاهرة .

٢ ـ تأثير المسارات الطبيعية :

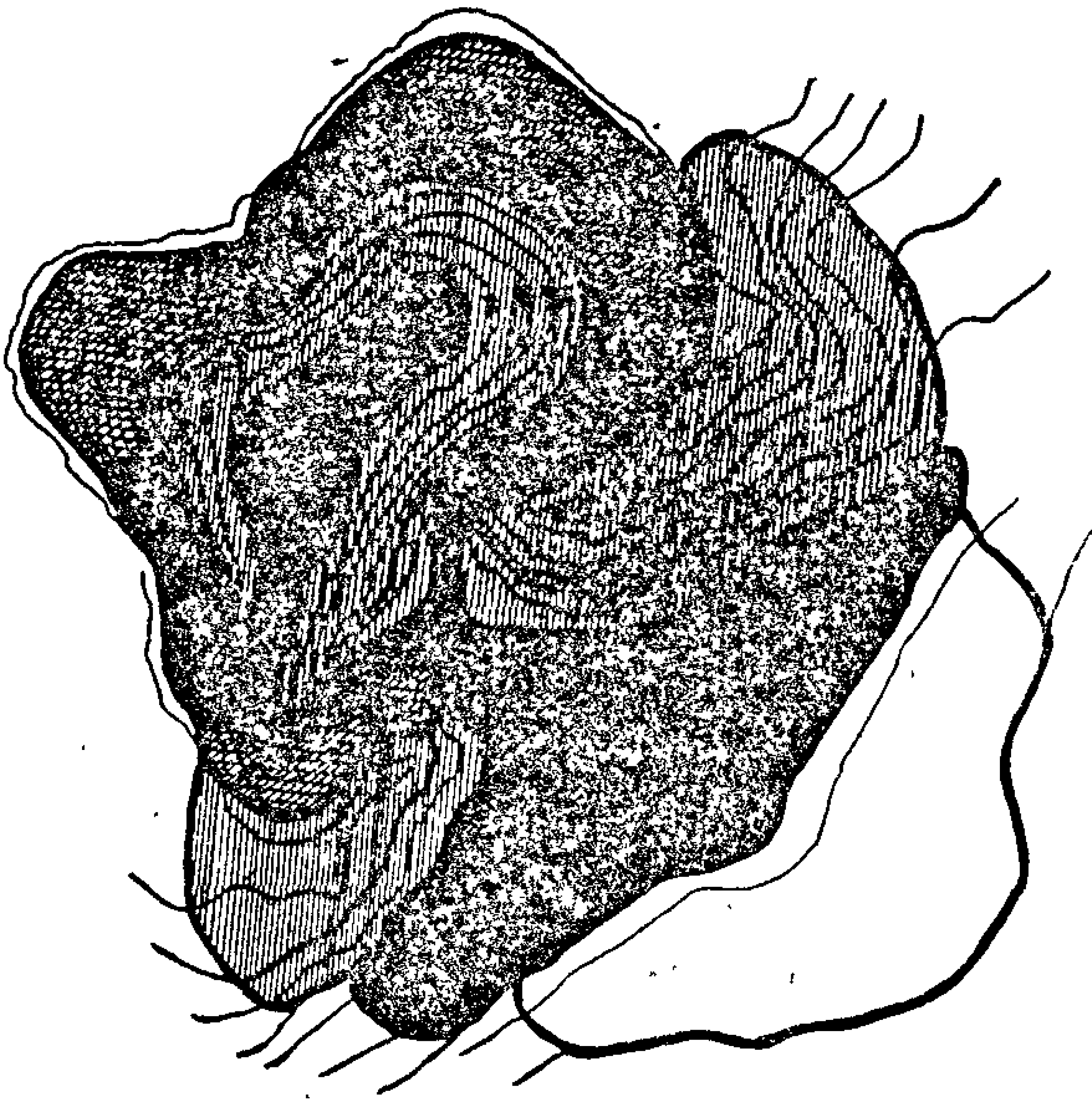
ومن بين خطوط قمم الجبال وسلاسلها نجد ان بعض هذه السلاسل والخطوط تمتاز بميول شديدة والبعض الآخر بالميول البسيطة وسلاسل الجبال التى تكون ميولها مناسبة للحركة فى الصعود والنزول تسمى بالمسارات الطبيعية ويمكن تقسيم هذه المسارات الطبيعية حسب ميولها الى عدة أقسام الميول البسيطة وهذه لا يتجاوز ميلها عن ٤٪ ـ أما الميول المتوسطة فهى من ٤٪ ـ ٧٪ وكما يمكن استخدام سلاسل الجبال التى يصل ميلها من ٧ ٪ الى ١٢ ٪ وهذه الانواع من سلاسل الجبال وميولها المختلفة يمكن للانسان ووسائل الحركة استخدامها فى الصعود الى قمم الجبال أو النزول الى مناطق القيعان وتسمى بالطرق والمسارات الطبيعية أما اذا زاد الميول عن ١٢ ٪ وأصبحت شديدة الانحدار فتصبح حركة الصعود والنزول غير ميسرة وتحتاج لتعديل فى طبوغرافية الأرض لتقليل الميل ولذا لا تعتبر سلاسل الجبال ذات الميول الشديدة الانحدار من المسارات الطبيعية حيث أنها تحتاج لتمهيد من صنع الانسان .

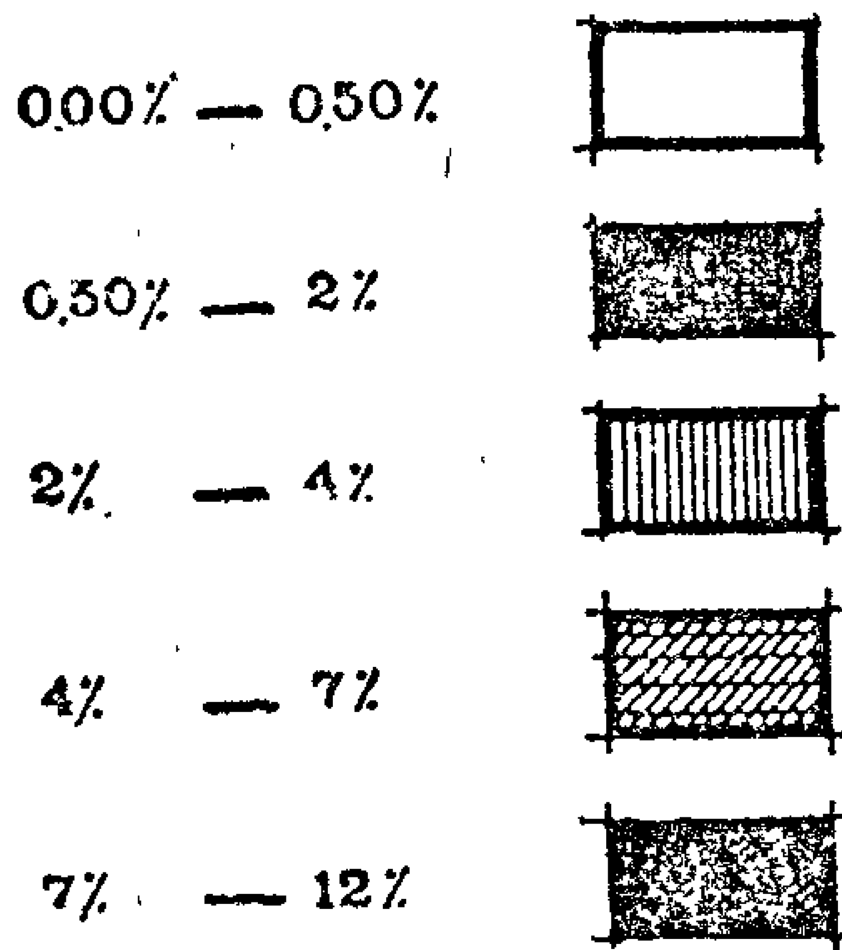
كما يتعين على الانسان أن يدرس طبوغرافية الأرض دراسة وافية حتى يمكن تحديد هذه المسارات الطبيعية واستخلاصها من خطوط قمم الجبال أو سلاسل الهضاب المرتفعة وكما يتعين عليه تحديد مخرات السيول حتى لا تقع بها مسارات الحركة الراسية وتستطيع أن تستخلص العديد من المسارات الطتيعية أو المدقات الطبيعية من خطوط القمم والسلاسل الجبال التى تصل أعدادها فى بعض الأحيان الى المئات والآلاف (شكل رقم ٢ ، ٣) .

٣ ـ شبكة الطرق :

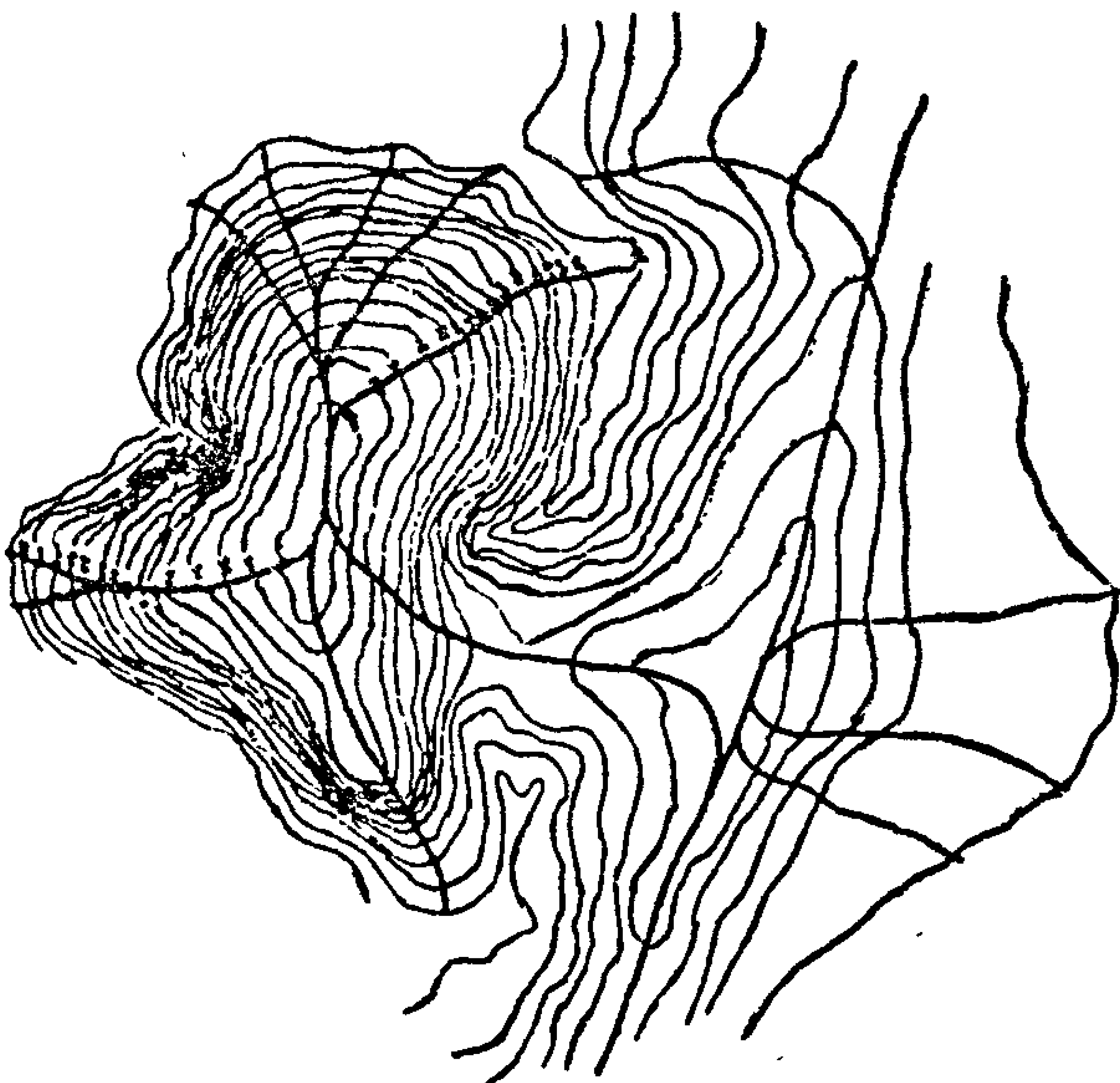
ويستطيع المخطط والمصمم للطبيعة أن يختار ويفاضل بين المسارات الطبيعية السابق شرحها واختيار أمثلها للوصول الى العديد من الاقتراحات والحلول والبدائل التخطيطية لشبكة الطرق الرئيسية للمدينة ويمكن تقسيمها الى نوعين :

ـ طرق راسية تقوم بتوزيع الحركة من أسفل (من القيعان) الى أعلى (الى القمم) وهى المسارات التى تم اختيارها من خطوط القمم



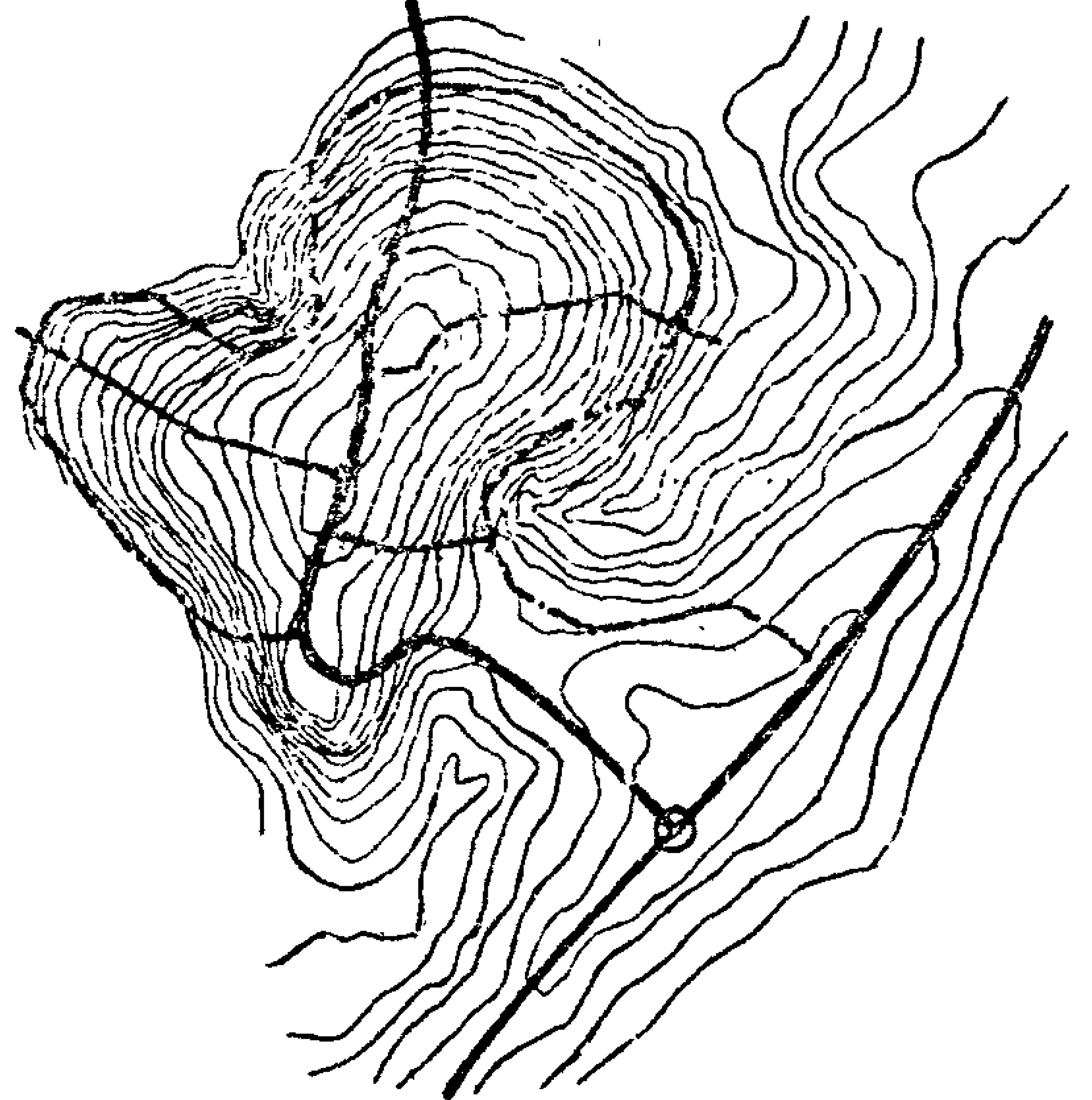


شكل رقم ٢ الميول الطبيعية
Slopes



شكل ٣ المسارات الطبيعية
Natural Trails

وسلاسل الجبال والمسارات الطبيعية وغالبا تكون هذه المسارات هى الطرق الرئيسية بالمدن مكونة الشرايين الرئيسية للحركة ومراكز الاحياء بالمدينة وتربطهم بقلب المدينة وتمثل عصب المدينة الرئيسى (شكل رقم ٤) .



Street Pattern Alternativ

Vertical circulation

Horizontal circulation

Main city spine

Major Arterials

Minor Arterials

شكل رقم ٤ الطرق الرئيسية بالمدينة

ـ طرق افقية تقوم بتوزيع الحركة ونقلها افقيا ويتبع مساراتها الخطوط الكونتروية وتكون موازية تقريبا وغالبا ما تكون هذه الطرق هى الطرق المغذية لمراكز المتجاورات وتربطهم بمركز الاحياء وتأخذ الشكل الدائرى فى أغلب الأحيان وتمثل بعصب الحى أو بالطريق الثانوى أو بالشريان الثانوى ، ويتشعب منها ـ طرق مجمعة تغذى المجموعات السكنية وتربطها بمركز المتجاورة وتسمى بعصب المجاورة ويتفرع منها طرق سكنية تخدم على المساكن مباشرة وتمثل عصب المجموعة السكنية ، وغالبا ما تكون طرق مقفولة النهاية او طرق دائرية صغيرة .

(ب) شبكة المجارى :

تساعد الطبيعة المصمم فى التخطيط الامثل لشبكة المجارى حيث تفرض طبوغرافية الارض الموقع الامثل لمحطة معالجة المجارى ـ وبالقرب من مناطق القيعان وتمتد خطوط المجارى على المسطحات المائلة لطبوغرافية الارض راسيا مما يسهل اندفاع المجارى بها نتيجة الميول الطبيعية ونتيجة الجاذبية الطبيعية .

(ج) شبكة تغذية المياه :

كما توضع خزانات المياه فى المناطق القمم مما يسهل تدفقها نتيجة الميول الطبيعية لطبوغرافية الارض الى كافة عناصر المدينة دون حاجة الى طلمبات لتغذية المنازل أو المبانى كل على حده وذلك كما يستخدم المصمم العمرانى خزانات المياه التى غالبا ما تكون شاهقة الارتفاع وتمتاز بالرأسية كعناصر مرئية وكعلامة مميزة تؤكد مناطق القمم حيث يوجد غالبا قلب المدينة أو الحى .

ثانيا ـ تأثير الطبيعة على استعمالات الاراضى بالمدينة :

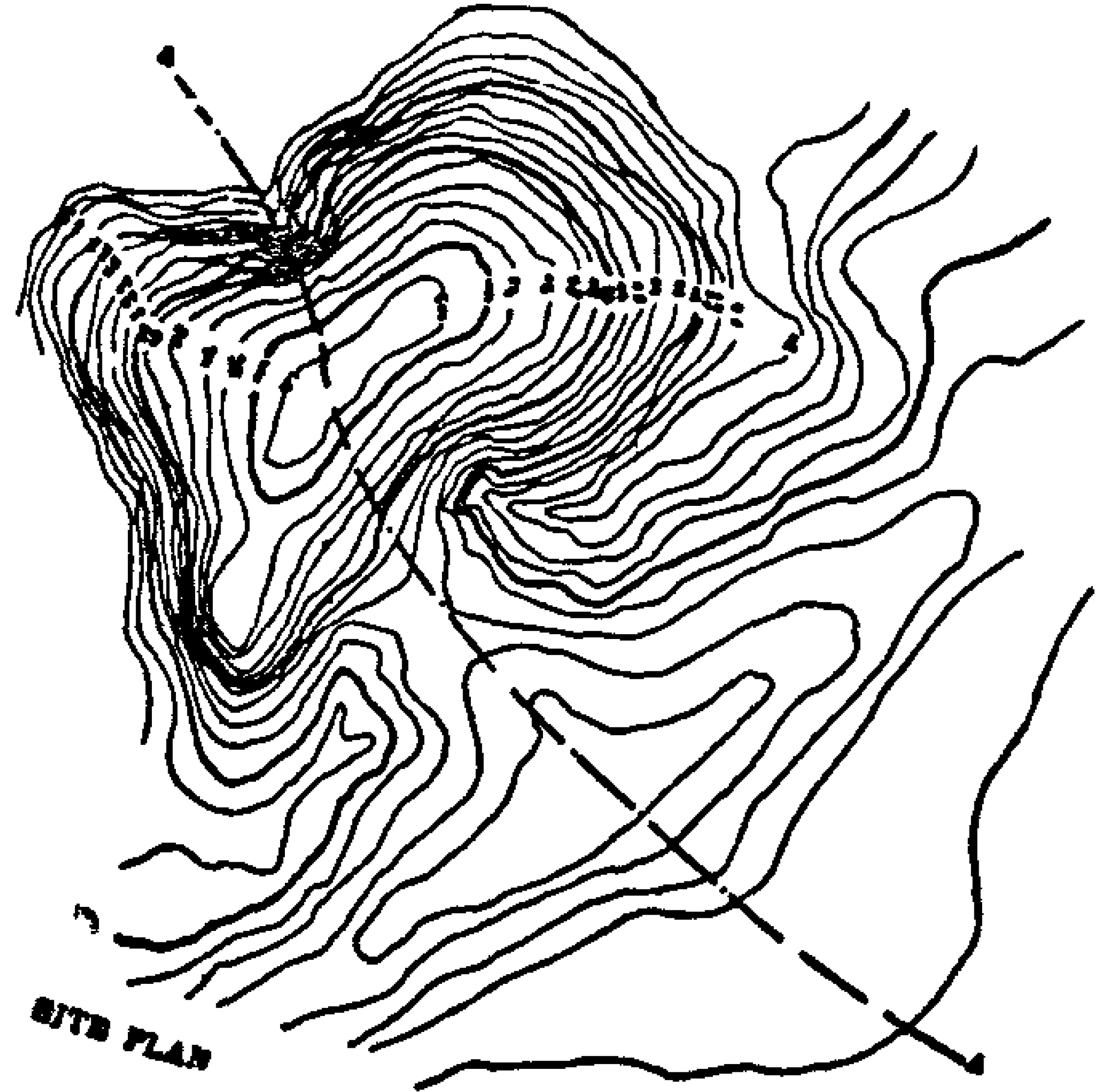
وتفرض الطبيعة نفسها على المخطط والمصمم على التخطيط الامثل والتوزيع الامثل للاستعمالات للعناصر المختلفة بالمدينة طبقا للتحليل المبين بالشكل رقم ٥ ، ٦ وكما يلى :

(أ) البدائل التخطيطية لموقع المركز المدينة على طبوغرافية الارض :

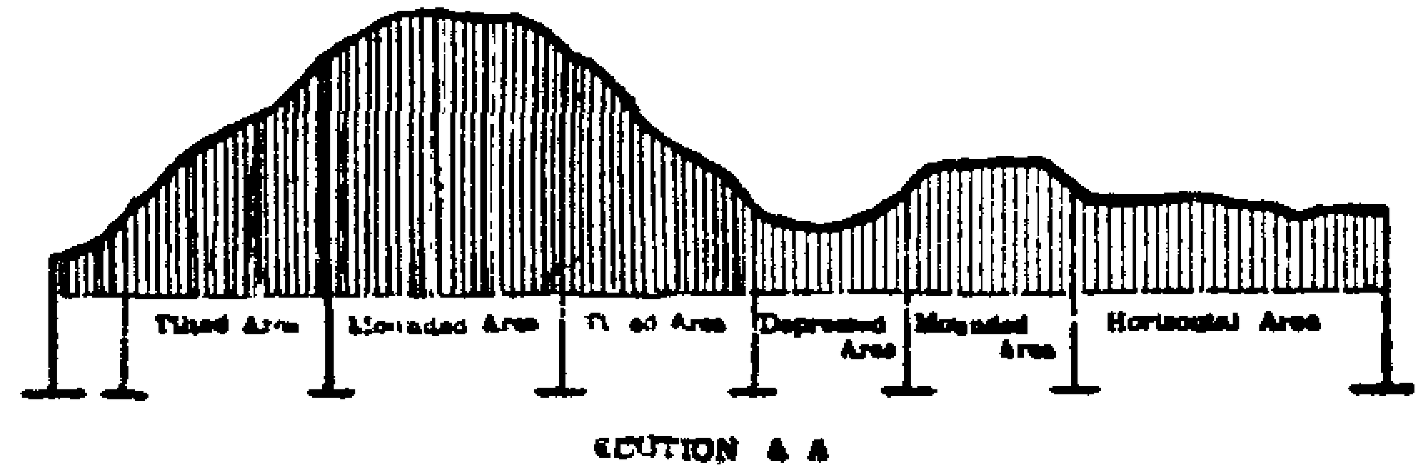
يحتوى المركز على المنطقة التجارية والادارية الرئيسية التى تمثل قلب المدينة ويمكن تلخيص هذه البدائل فيما يلى :

١ ـ **البديل الاول ـ** غالبا ما يقع المركز على مناطق القمم حيث تمتاز هذه المناطق بارتفاع قيمة الارض بها لتمتعها بالتوجيه الخارجى فى جميع الاتجاهات ورؤيا للمناظر من أعلى فى جميع الاتجاهات كما تمتاز منطقة القمة بأنها عنصر مرئى من جميع المناطق التى تحيطه وبأنها عنصر مسيطر على كافة أشكال الارض الاخرى نظرا لارتفاعها الشاهق .

كما يؤكد مركز المدينة مناطق القمم نظرا لارتفاع المبانى به تأكيدا صريحا لطبوغرافية الموقع فى مناطق القمم .



Natural Environment Studies



Ground Simple Form Units اشكال الارض البسيطة	Mounded Plane مستوى القمة	Tilted Plane مستوى مائل	Depressed Plane مستوى القاع	Flat Plane مستوى افقي
Amount Of Enclosure	Non Enclosed Space غير محدد	Slight Enclosure On One Side شبه محدد	Closed Space محدد	Non Enclosed Space غير محدد
View	Mounded Area Out Ward Orientation 360° Panorama View	Tilted Area Out Ward Orientation In One Direction	Depressed Area In Ward Orientation 360°	Horizontal Area Neutral Orientation & Direction
Constructing Suitability	I	II	IV	III
Agricultural Suitability	IV	III	I	II
Scenic Value	I	II	III	IV
Land Value	I	III	II	IV
	I	I فوق المتوسط	III متوسط	IV
Vegitation	Light Wooded Area		Heavy Wooded	Medium Wooded

شكل رقم ٥ دراسة تحليل البيئة الطبيعية

ومن عيوب هذا البديل عدم الربط بين منطقة المركز والمنطقة الترفيهية والمسطحات الخضراء التى يتعين أن تقع بمنطقة القاع ـ وأيضا نضارب حركة السكان حيث تكون حركتهم لأعلى الوصول الى المركز ولاسفل للوصول للمنطقة الترفيهية والمنطقة الخضراء الا أنه فى بعض الاحيان يفضل بعض مخططى الطبيعة فى حالة الاستحالة الصعود الى القمة ونظرا لصعوبة تمهيد الطرق اليها وعدم وجود مسارات طبيعية تصل اليها ولوجود ميولا شديدة الانحدار بالمناطق المحيطة وبذلك تكون البدائل التخطيطية لانسب موقع للمركز .

٢ ـ **البديل الثانى ـ** أن يقع المركز فى أعلا المنطقة تلى منطقة القمة أو أن يقع فى منطقة تتوسط المدينة وفى كلتا الحالتين تكون على المستوى المائل ومثال ذلك مدينة الامل حيث اضطر المخطط أن يضع مركز المدينة فى منطقة متوسطة على السطح المائل ـ آخذا فى الاعتبار ثلاثة عوامل رئيسية أولهما استحالة الصعود الى قمة الجبل نظرا للميول الشديدة الانحدار وثانيهما استحالة انتشار المدينة حول قمة الجبل نظرا لارتفاعها الشاهق وشدة الرياح فى الناحية الشمالية ـ وثالثهما المحافظة على منطقة القاع كمنطقة ترفيهية وزراعية ومن عيوب هذا الحل أن نصف المدينة يضطر للصعود الى المركز والنصف الاخر يضطر للنزول الى المركز ـ مما يقال من أحد المقياس الرئيسية فى التخطيط وهو التوجيه الامثل لكافة المدينة ـ كما أن نصف المدينة المحصور بين منطقة المركز ومنطقة القاع (المنطقة الترفيهية) يتمتع بأنه قريب من المنطقتين الرئيسيتين بالمدينة ـ فى حين أن النصف الاخر من السكن يبعد عن المنطقة الترفيهية مما يسبب عدم تكافؤ الفرص لشطرى المدينة .

٣ ـ **البديل الثالث ـ** أن يقع المركز فى منطقة القاع وفى هذه الحالة يتعين على المخطط أن يتأكد من عنصرين هامين أولهما :

ـ تحديد منسوب مياه الفيضانات حتى لا يقع أى مبانى أو منشآت به .

ـ وثانيهما تحديد المسطحات الترفيهية ومسطحات المناطق الخضراء الواجب تركها حول منطقة القاع قبل تحديد موقع مركز المدينة ـ ويمتاز هذا البديل باربع خصائص هامة :

الاول ـ تجميع الاستعمالات الرئيسية مثل مركز المدينة والمسطحات الترفيهية والمسطحات الخضراء ـ بمنطقة البؤرة المركزية للموقع طبقا لشكل طبوغرافية الارض .

الثانى ـ التوجيه الامثل للمدينة ويساعد هذا التجميع على توجيه جميع العناصر السكنية بالمدينة حول منطقة القاع التى تتمركز فيها الاستعمالات الرئيسية بمختلف انواعها ودائما ما تكون الحركة لاسفل لمركز المدينة والاستعمالات الرئيسية ولاعلى للمناطق السكنية .

الثالث ـ الاحساس بالانتماء لسكان المدينة ويعطى تجميع الاستعمالات الرئيسية فى البؤرة المركزية للموقع احساس سكان المدينة بالانتماء لمدينتهم بطبوغرافيتها المتميزة نظرا لتوحيد العناصر البصرية للبيئة الطبيعية لهم جميعا ولتمتعهم بمناظرها الخلابة من أعلا .

الرابع ـ تكافؤ الفرص ويمتاز هذا البديل بتكافؤ الفرص لجميع السكان ـ حيث تتساوى

مسافة الوصول الى المنطقة المركزية للمدينة من جميع الاحياء التى تحيط بهذه المنطقة بالتساوى تقريبا .

ومن عيوب هذا البديل عدم تأكيد طبوغرافية الموقع فى منطقة القمة .

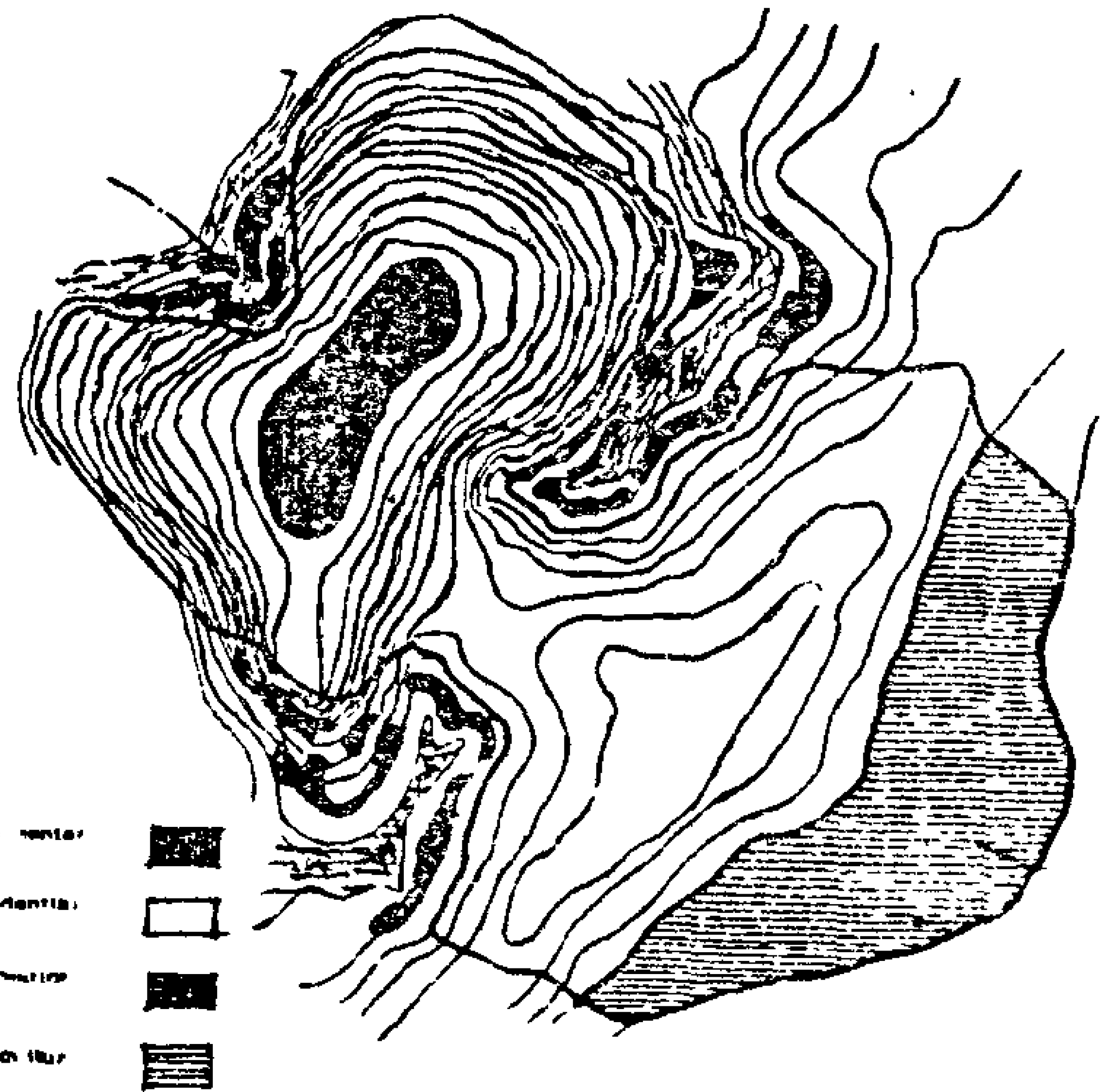
(ب) الاستعمالات السكنية :

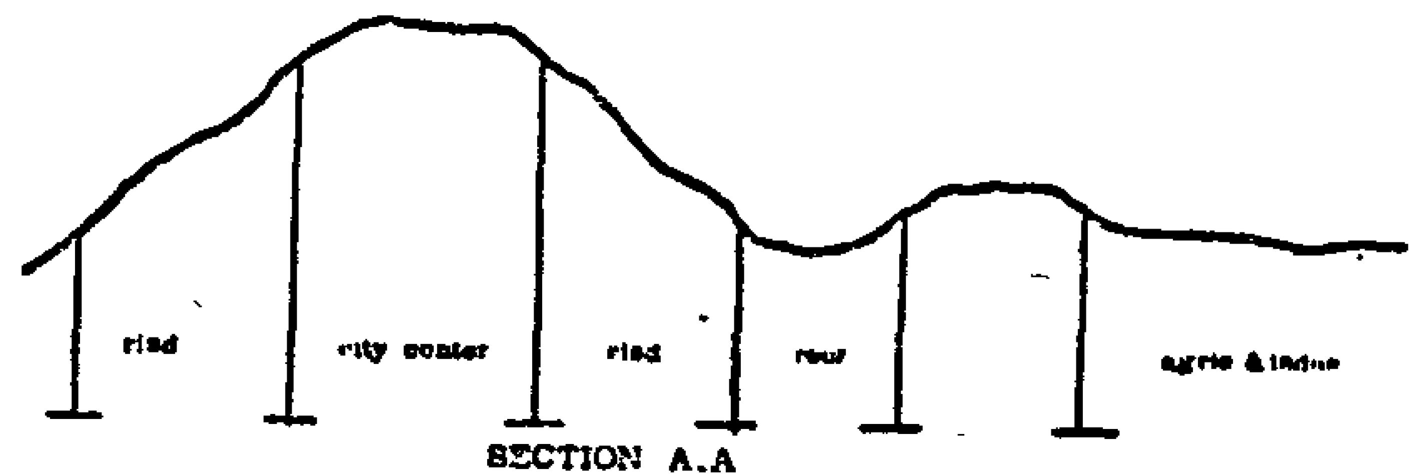
ويعتبر السطح المائل انسب المواقع للمناطق السكنية للاسباب التالية : —

١ — يتمتع بتوجه خارجى فى اتجاه واحد فى اتجاه منطقة القاع الغنية بالعناصر الطبيعية مثل المسطحات المائية والتشجير الكثيف .

٢ — يمتاز بمنظر عام من منطقة مرتفعة الى منطقة القاع السابق ذكرها بعناصرها الخلابة .

٣ السطح المائل هو السطح المتصل بمنطقة القمة ومنطقة القاع على التساوى مما يجعل الحركة منه سهلة سواء لمنطقة القمة حيث يوجد مركز المدينة — أو الى منطقة القاع حيث يوجد المسطحات والاستعمالات الترفيهية والمسطحات الخضراء وتعتبر القيمة الاقتصادية للاراضى على المستوى المائل من الدرجة الثالثة بعد منطقة القمة ومنطقة القاع نظرا للميزات السابق شرحها — مما يجعلها اصلح عناصر طبوغرافية الموقع للمناطق السكنية (شكل رقم ٦) .





شكل رقم ٦ تأثير الطبيعة على استعمالات الاراضى

(ج) المناطق الترفيهية والمناطق الخضراء والمفتوحة :

لا يوجد موقع بديل لمنطقة القاع يصلح للمناطق الترفيهية والخضراء والمفتوحة للعوامل التالية :

١ — تجمع المياه بمنطقة القاع مكونة البحيرات والانهار والمستنقعات .

٢ — لكونها مغمورة بالمياه مما يجعلها صالحة للزراعة والتشجير من الدرجة الاولى .

٣ — وتمتاز هذه المنطقة بعناصرها الجذابة ذات القيمة الجمالية المرتفعة مثل المسطحات المائية الابحار — والانهار — والبحيرات والمستنقعات — والمساقط المائية — وكذا عناصر التشجير الكثيفة والغابات مما يجعل قيمتها الاقتصادية للاراضى مرتفعة تلى منطقة القمة .

(د) المناطق الصناعية والزراعية للمدينة :

لا يوجد موقع بديل لمناطق الافقية من عناصر طبوغرافية الموقع يصلح سواء للصناعة أو للزراعة طبقا للعوامل التالية : .

١ — تحتاج الزراعة الى مسطحات افقية للامتداد الافقى وتخصيصها للزراعة عند تخطيط اى موقع سواء فى الصحراء أو خلافها — حيث أن المسطحات الافقية يمكن تمهيدها ومعالجتها وزراعتها بسهولة بخلاف كل من منطقة القمة أو المناطق المائلة أما منطقة القاع دائما مغموره بالمياه بالاضافة الى انها قيمتها الاقتصادية مرتفعة جدا لاحتوائها على عناصر ترفيهية من الدرجة الاولى بحيث لا يمكن تخصيصها للزراعة أما منطقة القمة والمناطق المائلة لا تحتفظ بمياه الامطار — فى حين ان المناطق الافقية تمتاز باحتفاظها بمياه الامطار والرى لمدة طويلة حتى تمتصها الارض .

٢ — ونظرا لعوامل الجوية المختلفة مثل حركة الهواء وضغطه ودرجة حرارته ورطوبته وخاصة بالمناطق الشديدة الحرارة مثل جمهورية مصر العربية وصحرائها فانه يستحيل وضع الصناعات فى منطقة القاع او المنطقة المائلة او قريبا من سطح مائى شاسع — مما يجعل المسطحات الافقية من اشكال الارض السابق شرحها هى انسب المواقع للصناعات بانواعها .

الخلاصة : بدائل الموقع لمركز المدينة تحدد التخطيط العام لمنطقة اما باقى العناصر فان الطبيعة وطبوغرافية الموقع تحتم مواقع محددة لها — واذا ما استطاع المخطط تفهم الطبيعة

واشكالاها استطاع ان يخطط مع الطبيعة وحولها فى تنسيق تام وتكامل واضح وينتج عن ذلك مدينة منسجمة مع طبيعة الموقع ومؤكدة لعناصره اما اذا لم يستطع تفهمه فانه اما يعلن عدم كفائته للتعامل مع الطبيعة واشكالها أو ياجا الى المواقع الافقية رافضا استخدام الطبيعة وشكالها وعناصرها الجذابة وانه يلجأ الى هدم العناصر الطبيعية واشكالها لتصبح مستويا افقيا يستطيع ان يتعامل معه وذلك عندما يعجز عن ايجاد موقع افقى مما يؤكد فشله فى تفهم عناصر الطبيعة واشكالها والتصميم والتخطيط معها .

ومما هو جدير بالذكر ايضا ان توجد مواقع طبيعية تحتم اختيار بديل معين من بدائل التخطيطية لمواقع المركز الرئيسى للمدينة مما يحتم بالتالى تخطيطها معينا تماشيا مع الطبيعة.

ثالثا – تاثير الطبيعة فى تخطيط الهيكل العام

تؤثر طبوغرافية الموقع والعناصر الطبيعية تأثيرا قويا على تخطيط الهيكل العام للمدينة ووضوحه – فاذا ما استطاع المخططين والمصممين تحليل العناصر الطبيعية تحليلا دقيقا وتفهموا خصائصها ومميزاتها وأشكالها وعناصر القوى المؤثرة فيها فاننا نجد أن الطبيعة يمكن الاستفادة منها وتسخيرها للوصول الى التخطيط الأمثل للهيكل العام للمدينة وتوضيح خلايا المدينة والفصل فيما بين هذه الخلايا طبقا لتدرجها الهرمى بالمدينة أى على مستوى المجاورة او الحى او المنطقة حسب نوع المدينة وحجمها سواء كانت مدينة صغيرة تتكون من حى واحد او مدينة كبيرة تتكون من عدة أحياء وعدة مناطق ويأتى **هذا الفصل صريحا وقويا كما يلى :**

١ – بواسطة الطرق الرئيسية والتى تفصل بين كل منطقة واخرى فى المدينة – لكونها تمر بخطوط القمم الرئيسية بالموقع وهى تمثل المسارات الطبيعية الرئيسية بطبوغرافية الموقع للحركة الراسية من اعلى الى اسفل .

٢ – الطرق الثانوية والتى تفصل بين الاحياء وبعضها وتتشعب من الشرايين الرئيسية كشرايين ثانوية ومساراتها هى خطوط القمم من الدرجة الثانية من طبوغرافية الموقع وتمثل المسارات الطبيعية الراسية الثانوية بالموقع .

٣ – الاوردة الصغيرة وتتشعب من الشرايين الثانوية وتفصل بين التجاورات ، وهذه الاوردة الصغيرة تتكون غالبا من مسارات الشعب الصغيرة المتفرعة من خطوط القمم والمسارات الطبيعية الثانوية .

وحيث أن جميع هذه المسارات هى خطوط قمم ومسارات طبيعية راسية من درجات مختلفة – فجميعها يمثل الخط الذى يصل بين اعلى نقط قمم فى المنطقة التى يقع فيها ويحيطه من الجانبين مستويات مائلة – مما يجعل هذا الفصل صريحا وواضحا .

وبالاضافة الى ذلك فانه دائما يقع خط مخر السيول بين كل خطين من خطوط القمم وينتهى بمنطقة القاع والتى تعتبر ، حد ذاتها نهاية المستويات المائلة التى تحد كل خطين من خطوط القمم على حده وبذلك تكون حدود أى خلية من خلايا المدينة على اختلاف حجمها محددة المعالم والتشكيل بخطين قمة وبينهما خط قاع – مكونا وعاء اخضر ينتمى الى بؤرة تركيز رئيسيئة وهى نقطة القاع (شكل رم ٧) .



شكل رقم ٧ تاثير الطبيعة على تركيب المدينة

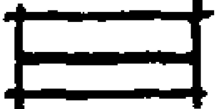
Nature&City Structure

Heiraichy of City Cells

Community cell 

Neighbourhood cell 

Main spine 

Secondary spine 

ويحقق هذا التشكيل الطبيعى الرائع ما يلى :
٣/أ ــ تحديد الشكل العام لهيكل المدينة ووضوحه .

٣/ب ــ اعطاء شخصية مستقلة لكل خلية من خلايا المدينة عن الأخرى .

٣/جـ ــ تحديد أشكال الخلايا بالمدينة حسب تدرجها الهرمى فى تنسيق وانسجام تام مع الطبيعة .

٣/د ــ الاختلاف والتباين بين البيئة الطبيعية لكل خلية على حده الناتج عن اختلاف اشكال الخطوط الكنتورية (خطوط تشكيل الأرض) الواقعة فى كل خلية على حده ــ يعطى لكل خلبة مناظر خلابة مختلفة عن الخلية الأخرى سواء فى بؤرتها نقطة القاع او على اسطحها المائلة .

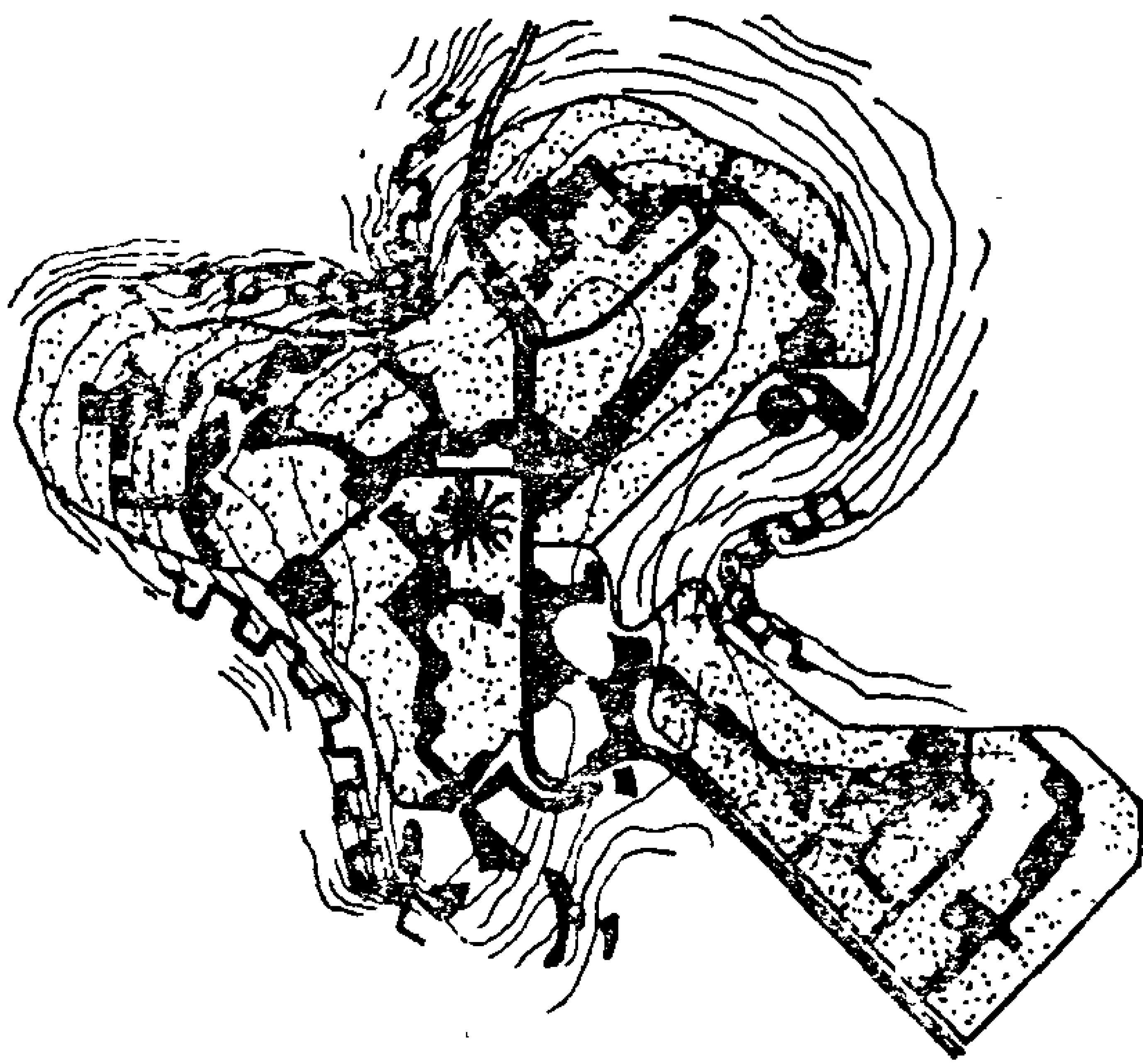
٣/هـ ــ وينتج عن هذا التباين والاختلاف الانتماء الاجتماعى لسكان كل خلية على حده لارتباط ذهنهم بالمناظر الطبيعية التى تتمركز فى بؤرة الخلية فى منطقة القاع من عناصر التشجير والمجرى المائى المار بها وعناصر الطبيعة التى تختلف فى مكوناتها وأشكالها والقوى المؤثرة فيها عن مثيلتها فى اى خلية أخرى من خلايا المدينة .

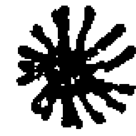
وبذلك يكون المخطط قد استطاع الاستفادة من الاشكال والعناصر الطبيعية وتسخيرها القوى المؤثرة فيها فى تخطيط امثل متناسق مع الطبيعة ومنسجم تماما مع عناصرها وأشكالها وقواها .

رابعا ــ كيف تؤثر الطبيعة على التصور العام للمدينة :

ومن الجدير بالذكر أن الطبيعة بمختلف اشكالها وعناصر والقوى المؤثرة فيها تساعد المخطط فى توضيح الصورة العامة للمدينة وربطها بذهن سكانها وسهولة تخيلها وربط عناصرها ببعضها فى تكوين تصور وتخيل عام سهل الوضوح على كل ساكن بالمدينة وذلك اذا ما استطاع المخطط والمصمم تفهم هذه الأشكال والعناصر والقوى واستطاع ان يستفيد منها وان يحافظ عليها وان يصمم لها كما يصمم للانسان معها وحولها دون هدم أو تخريب أو مجرد الاقلال من عظمتها الطبيعية ــ كما يمكنه تسخير قواها لما يفيد تخطيطه لصالح الانسان ــ وتأكيد أشكال وعناصر الطبيعة بما يفرض عليها من عناصر من صنعه لراحة الانسان فى تخطيط سليم ومتناسق ومتجانس ومتكامل مع الطبيعة .

ومثال هذه العناصر الطبيعية التى ترتبط ارتباطا وثيقا بذهن وتصور الانسان عن البيئة التى يعيش فيها (شكل رقم ٨) كما يلى :



Land Mark 

Nodes 

Paths 

District 

Edges 

شكل رقم ٨ تأثير الطبيعة على التصور العام للمدينة

العلامات المميزة : hand mark

وليس اميز من منطقة القمة او قمة الجبل فى اى موقع ــ نظرا لكونها اعلى منطقة ومسيطرة على ما حولها من العناصر الطبيعية فاذا ما استطاع الانسان ان يضع فى هذه المنطقة المبانى المرتفعة وعناصر المدينة ذات الامتداد الرأسى (مركز المدينة) فانه مما لا شك فيه يؤكد هذا العنصر الطبيعى الشامخ تأكيدا صارخا وقويا وملموسا كما يحافظ على هذا العنصر الطبيعى الهام ــ ويساعد على ارتباط مركز التنمية كعنصر هام ومسيطر بارتباطا وثيقا يمثله من عناصر الطبيعة الهامة القمة ــ ويساعد التحام العنصرين المتجانسين وتنسيقهما تنسيقا جيدا ــ فى خلق تصور واضح وصريح لهما بذهن ساكن المدينة وتصبح نقطة القمة هى العنصر المرىء الرئيسى بالمدينة كما هى العنصر المرىء بالطبيعة .

٢ ـ المناطق الطبيعية : Districts

وكما سبق شرحه فان بالطبيعة مناطق متميزة ومحددة بخطوط القمم ومخرات السـيول ـ وباختصار فان كل خطين قمة يتوسـطهما مخر سيل وتكون هذه المجموعة منطقة محددة طبيعيا بحدين رئيسيين وهما خطي القمـة ـ وتمتـاز ببؤرة تركيز وهى منطقة القاع لعناصرها الجذابة من الغابات الطبيعية والتشجير ومساقط المياه والمستنقعات ان وجدت وخطوط تشكيل الأرض وكل هذه العناصر تميز منطقة عن أخرى تميزا واضحا وتكون درجة التباين والاختلاف فى منطقة عن اخرى قوية نظرا لاختـلاف تماثل العناصر الطبيعية من منطقة الى أخرى .

وهذا الاختلاف والتباين الصريح يخلق تصور ويربط ذهن سـكان المنطقة الواحدة بعناصر طبيعية تختلف فى أشكالها وقواها وتباينها عن أى منطقة اخرى مما يخلق مناطق مميزة عن بعضها البعض الآخر ـ يستطيع المخطط اسـتعمالها كخلايا سكنية للمدينة تنتشر على المسـطحات المائلة وتمتاز ببؤورة تركيز فى منتصفها .

٣ ـ النـواة : Node

ومن العناصر الطبيعية الرئيسية التى تمتاز بالتركيز حول بؤرة واضحة هى منطقة القاع حيث يحيط بها المسطحات المائلة الطبيعية سواء من جميع الجهات أو من ثلاث جهات مكونة وعاء اخضر يتوسطه بؤرة تركيز غالبـا ما تكون بها النواه الرئيسية للخلية السكنية على اختـلاف حجمها .

ويتمركز فى هذه النواه الخدمات الرئيسـية للخلية متناسـقة وملتحمة مع المناطق الخضراء الطبيعية الموجودة بالقاع .

٤ ـ المسـارات : Paths

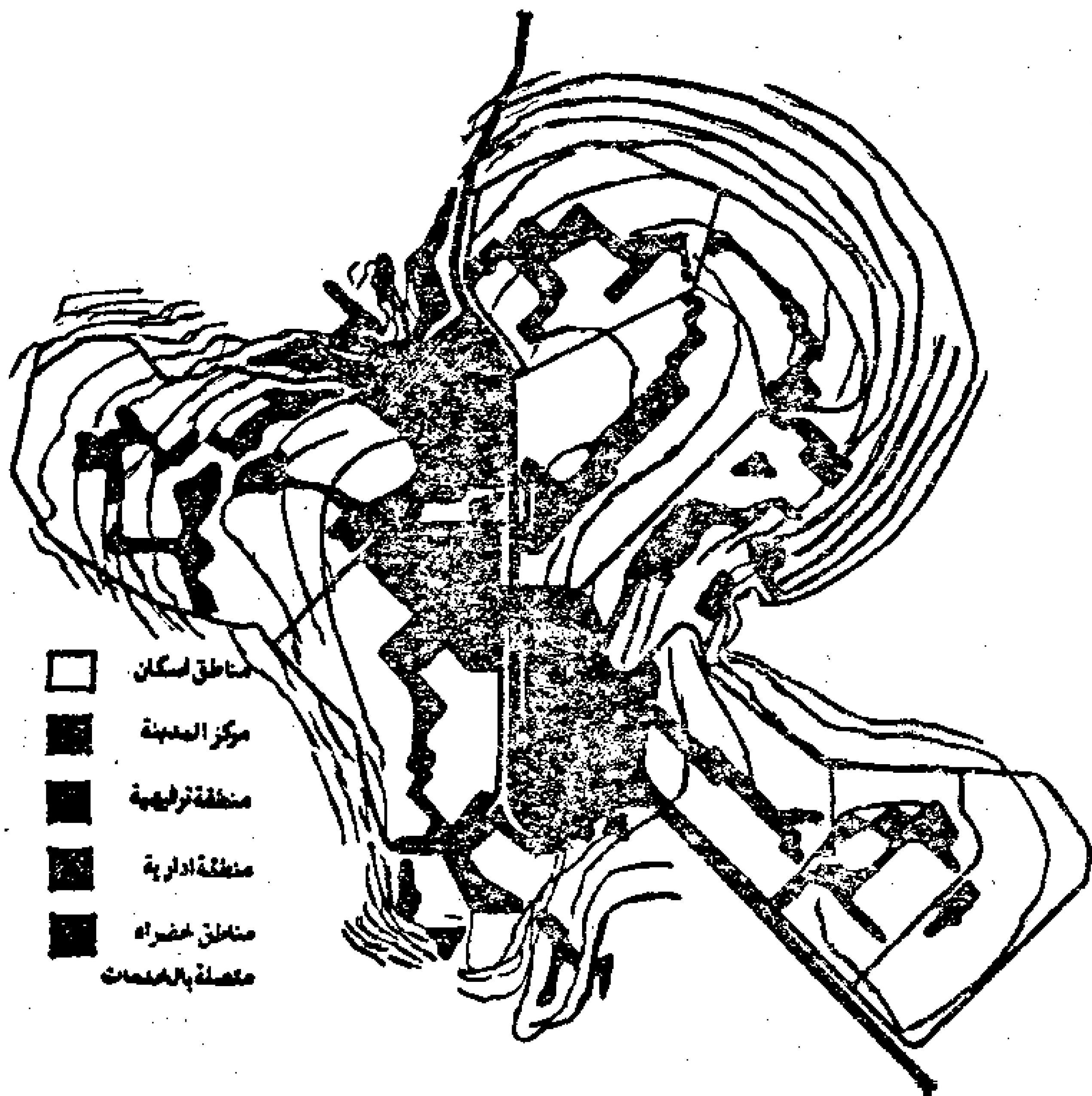
وتملى الطبيعة على المخطط مسارات طبيعية واضحة المعالم لكونها خطوط القمم وتكون هذه المسارات الطبيعية شـبكة الطرق الرئيسـية بالمدينة .

٥ ـ الحـدود : Edge

كما تشكل الميول الشديدة الانحدار بالطبيعة والمسطحات المائية الواسـعة ـ حدودا طبيعية للمدينة من حيث العمق والارتفاع والاسـتمرار والنوع والخطورة .

خامسا ـ التخطيط الأمثل للموقع :

مما لا شك فيه ان احترام المخطط والمصـمم للطبيعة وعناصرها الجذابة والغنية وتأكيده لها وتفهمه لخصائصها وأشـكالها وقواها المحيطة بها ـ ينتج عنه تنسيق تام بين الأشكال الطبيعية والأشكال التى من صنع الانسان ـ وانسـجام بين عناصر الطبيعة والعناصر المفروضة عليها من قبل المخطط ـ وتسخير واستفادة للقوى الطبيعية المؤثرة بالموقع فى التخطيط الأمثل للموقع (شكل رقم ٩) .



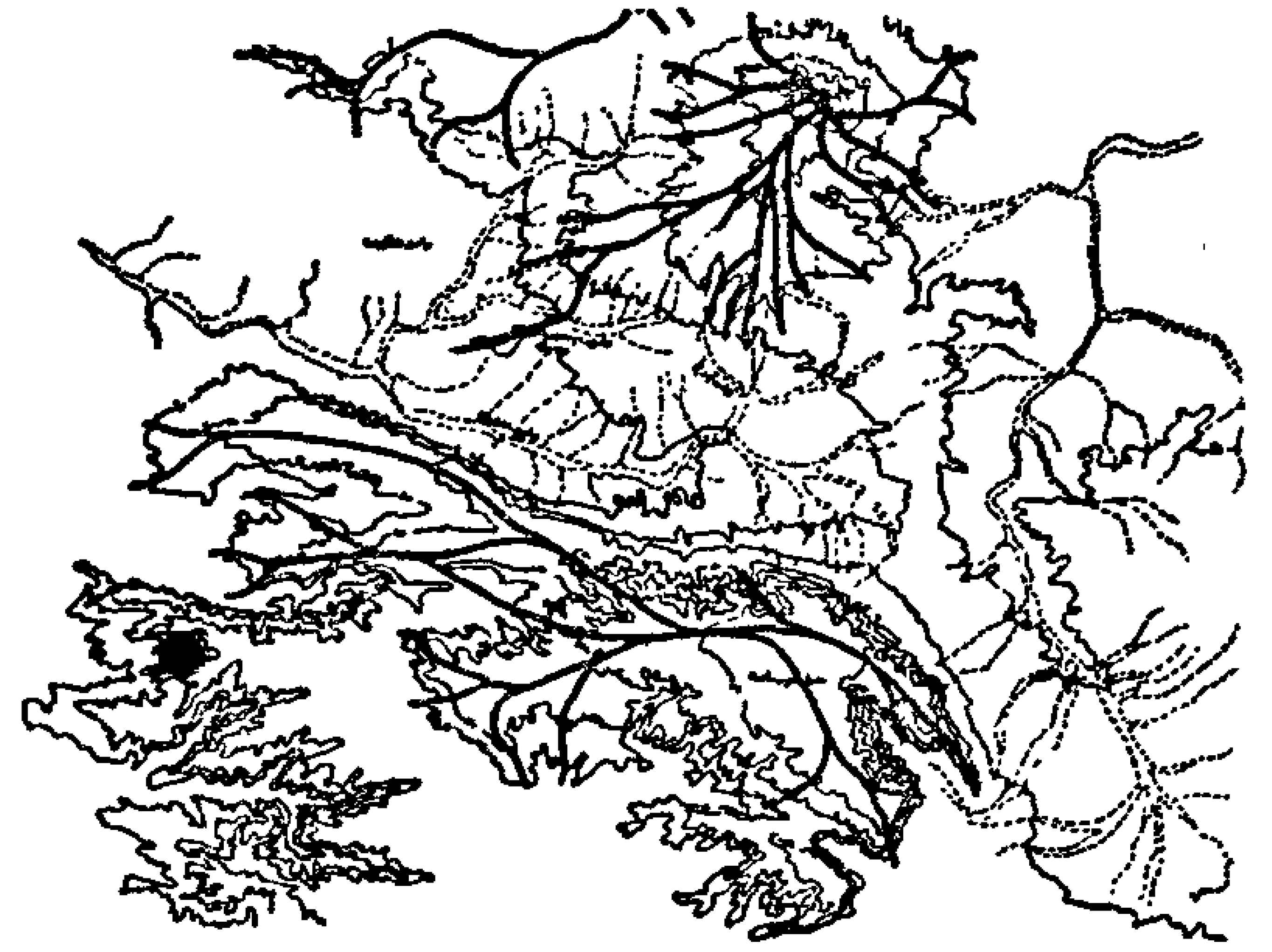
شكل رقم ٩ التخطيط العام للمدينة تتكون من احياء سكنية

البـاب الثـانى

دراسة تطبيقية لأحدى المدن الجديدة بالصحراء المصرية (مدينة الأمـل)

مدينـة الأمـل :

أحدى المدن الجديدة الثلاث التى تم تخطيطها لجذب سكان القاهرة الكبرى بالاضـافة الى مدينتى ٦ اكتوبر والعبـور ـ وتقع على محور رئيسى يربط القاهرة الكبرى بالبحر الأحمر وتعد الركيزة الجديدة للانشطة والتنمية العمرانيـة والاقتصادية على هـذا المحور وقد اسـتطاع المخطط ان يتفهم خصائص الطبيعة وعناصرها وقواها المحيطـة واشـكالها تفهما جيداً وان يخطط المدينة مع الطبيعة كما استطاع تسخير قواها لمنفعة الانسان ـ والدراسات التالية تبين كيف اثرت وساعدت طبيعة الوقع المختار على الوصـول الى التخطيط الأمثـل للمـوقع والدراسـات التـالية تبين تاثير طبيعـة الموقع وبيئته على التشكيل العمرانى (شكل رقم ١٠)



شكل رقم ١٠ طبوغرافية الموقع وخطوط القمم مخرات السيول

أولا ــ طبوغرافية الموقع :

يتمتع الموقع المختار طبوغرافيا وبصريا حيث تحيط به جبال من الشمال والجنوب استخدمها المخطط فى حماية موقع المدينة من الرياح الغير مستحبة . ويترك هذا التكوين الطبيعى بين الجبلين نفقا طبيعيا يمتاز بأن حده الشمالى المسطحات ذات الميول المعتدلة من جبل اليهموم الأسمر أما حده الاجنوبى فهو عبارة عن مخر سيل وادى أم رثم والحائط الرأسى شديد الميول من جبل أبو شامة بارتفاع ١٤٠ مترا ويصل ارتفاع أبو شامة الى ٥٦٠ مترا وارتفاع جبل اليهموم الأسمر الى ٥٠٠ مترا وينحدر انحدار شديد من القمة ثم انحدار طبيعى مكونا السطح المائل لموقع المدينة حتى منسوب ٤٣٠ مترا .

ثانيا ــ الحدود الطبيعية للموقع :

يمتاز الموقع بنوعين رئيسيين من الفواصل الطبيعية هما :

(أ) فاصل طبيعى ناتج عن الميول الشديدة للحد الشمالى جبل اليهموم الأسمر وميول رأسية حادة لجبل أبو شامة جنوبا ــ مما يجعل هذين الجبلين فاصل طبيعيا للمدينة من الدرجة الأولى وخاصة جبل أبو شامة حيث لا يمكن الصعود اليه من هذا الجانب .

(ب) مخرات السيول ذات الأعماق الشديدة والعروض الكبيرة التى تفصل بين الجبلين وتخلق فاصلا طبيعيا صريحا ومحسوسا من الدرجة الثانية .

ثالثا ــ مخرات السيول :

ويمر بالموقع مخرين للسيول احدهما يمر بوادى جندالى ويفصل بين الهضبة المنبسطة شرقا وجبل اليهموم الأسمر غربا ــ والآخر يمر بوادى أم رثم ويفصل بين جبل أبو شامة جنوبا وجبل اليهموم الأسمر شمالا ــ وتؤثر مخرات السيول على التخطيط العام للموقع حيث فرضت على المخطط احترام وجودها وفرضت تأثيرها على التشكيل العمرانى من حيث الآتى :

١ ــ صعوبة تغير الهيكل العام الطبيعى لهذه المخرات والتى تعطى فيما بينها مناطق محدودة للاستعمالات وكما تعتبر فى حد ذاتها فواصل طبيعية بين هذه المناطق وبعضها .

تمتاز عناصر البيئة بالموقع بطبوغرافية جذابة حيث يوجد التفاوت الواضح بين مخرات السيول وخطوط القمم . ومن أهم مميزات الموقع هذه الخطوط التى تمثل جميع نقاط القمم على أعلى الهضاب ، وتحدد هذه الخطوط فيما بينها فراغات عمرانية لطيفة . ويمكن الاستفادة من هذه الخصائص فى تصميم المدينة .

خامسا ــ المسارات الطبيعية :

تفرض طبوغرافية الموقع مسارات طبيعية وهى عبارة عن :

(أ) مسارات طبيعية ناتجة من خطوط القمم ذات الميول الخفيفة التى لا تزيد عن ٧٪ وأغلب هذه الخطوط منبثقة من جبل اليهموم الأسمر وتمثل هذه الحركة الراسية بالمدينة .

(ب) مسارات طبيعية موازية للخطوط الكنتورية وتمثل هذه المسارات الحركة الأفقية بالمدينة .

وهذه المسارات يحسن اخذها فى الاعتبارات عند تصميم الهيكل العام للمدينة المقترحة حيث أن هذه المسارات الطبيعية تشكل المسارات المفضلة كشبكة طرق ، وتؤثر فى اقتصاديات الانشاء للهيكل العام للمدينة حيث تتجانس شبكة الطرق المستنبطة من المسارات الطبيعية ذات الميول السهلة مع طبوغرافية الموقع مما لا يسبب تغيرا لمعالم الطبيعة للموقع ، وتقلل من تكاليف الانشاء التى ينتج عنها تغيير خطوط للارض والحفر والردم .

سادسا ــ الناحية الجمالية والبصرية :

يتميز الموقع بوجود محاور ومناظر طبيعية يجب مراعاتها عند اختيار التشكيل العمرانى للمدينة ، وتتلخص هذه المحاور فى الآتى :

(أ) محور رئيسى فى اتجاه الجنوب الغربى صوب جبل ابو شامة ووادى الثماح .

(ب) محور فرعى فى اتجاه الشمال الشرقى نحو اتجاه الوادى الفسيح لمخر سـيل وادى جندالى .

(جـ) محور فرعى فى اتجاه الشمال الغربى الى جبل اليهموم الأسمر فى الجانب الآخر من وادى جندالى .

وتخلق هذه المحاور منطقتين توجيه خارجى فى اتجاه واحد هما :

ـ منطقة تتجه اتجاها خارجيا فى مسار واحد الى ناحية الجنوب ، وتطل على منطقة وادى دجالة ومخرات السـيول والمنطقة الخضراء ، وتعتبر المنطقة الراسية بالمدينة .

ـ منطقة تتجه اتجاها خارجيا فى مسار واحد الى ناحية الجنوب الشرقى .

سابعا ـ اسـتعمالات الأراضى :

وتفرض الطبيعة نفسها مرة أخرى على الخطط فى التوزيع الأمثل للاستعمالات لعناصر المدينـة المختلفة (شكل رقم ١١) كما يلى :



شكل رقم ١١ استعمالات الاراضى

١ ـ منطقة تغمرها مياه السيول ويحسن عدم البناء عليها بل تسـتخدم كمنـاطق زراعيـة وترفيهية ، ويمكن الاستفادة بعناصرها الطبيعية الجذابة كممرات للمشـاه ذات قيمة جمالية طبيعية جذابة وتنقسم المناطق المحتملة للزراعة الى قسمين .

أ ـ مخرات السيول وقيعان الاودية وتوجد بها بعض الزراعات الحولية .

ب ـ مدرجات مخرات السيول الاودية الجافة التى يمكن زراعتها عند توفر المياه وتمتد هـذه المنطقة حتى خط كونتور ٤٠٠ .

٢ ـ مناطق شبه منبسطة شرق وادى جندالى تصلح للصناعة والمناطق المائلة للسكن .

ثامنا ـ تأثير الطبيعة على التخطيط العام للمدينة:

مما سبق تحليله نجـد أن الطبيعـة تفرض نفسها على المخطط والمصمم ـ فى الوصول الى التخطيط الأمثل للمدينة والتنسيق بين عناصر المدينة المختلفة والعناصر الطبيعية .

(أ) تخصيص منـاطق مخرات السـيول واستغلال الوديان الطبيعية وادى جندالى ووادى أم رثم كمناطق زراعية ويمكن أن تروى باستخدام المياه المتخلفة من الصرف الصحى بعد معالجتها .

(ب) يساعد زراعة الوديان والقيعـان على الاقلال ما احتمالات التلوث بالتصعيد فى فترة الحـرارة الزائدة نتيجـة تحـركات الهـواء الايروديناميكية .

(جـ) استخدام جبل أبو شامة كحد طبيعى رئيسى شاهق الارتفاع فى حماية المدينة من تأثير رياح الخماسـين المحتملة ما الاتجـاه الجنوبى الغربى .

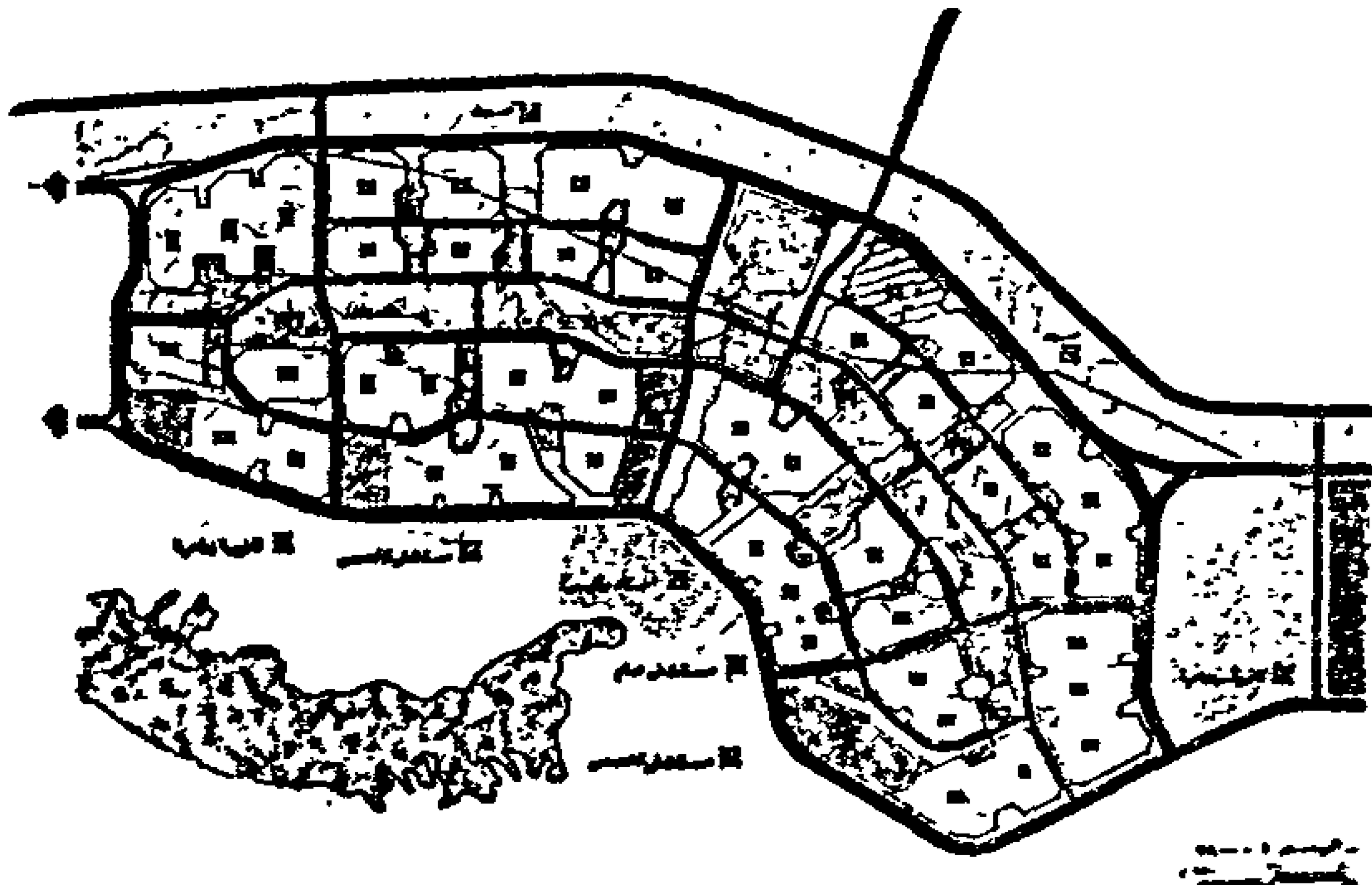
(د) الاستفادة من الميل الطبيعى للارض نحو الشمال الشرقى والجنوب الغربى لصرف مجارى المدينة .

(هـ) اسـتخدام التشـجير والعناصر الطبيعية فى تخفيف البيئة الصحراوية على المدينة بدراسة المناخ ومناطق الظل المحتملة .

(و) الاستفادة من اسـتخدام الفواصـل الطبيعية مثل مخر سيل وادى جندالى فى الفصل بين الصناعة وجسم المدينة .

(ز) تأكيد المحـاور البصرية الطبيعيـة والاستفادة منها بتوجيه المناطق السكنية اليها والتمتع بالنظر الى أسفل حيث توجد مخرات السيول والمناطق الخضراء الواسعة .

(ح) مراعاة مسطحات الفيضان المحتملة فى حالة السيول الشديدة حتى خط كنتور رقم ٤٠٠ (شكل رقم ١٢) .



شكل رقم ١٢ التخطيط العام للمدينة

تاسعا ـ الملامح الرئيسية للتخطيط العام من الوجهة البيئة والطبيعية :

وأثرت هذه المعايير على التخطيط العام للمدينة رغم تقيم البدائل واختيار البديل الأمثل الذى حقق انسجام تام بين الطبيعة وعناصر المدينة بأكملها ونتج عن ذلك تحديد الملامح الرئيسية للفكرة العامة لتخطيط المدينة .

(أ) تحديد شكل المدينة ـ فضل اختيار شكل المدينة على هيئة قوس كبير يمتد على منسوب متوسط ٤٢٠ مترا بمحور رئيسى شمال شرق وجنوب غرب بحيث يواجه القوس اتجاه الجنوب الغربى ، ويفضل وضع المنطقة الصناعية فى شرق المدينة ، مع فصلها عنها بفاصل من الأشجار الكثيفة يكسو الفاصل الطبيعى مخر سيل وادى جندالى .

(ب) هذا التشكيل يجعل المدينة فى جنوب غرب جبل الهموم الاسمر لحماية جسم المدينه من الاتجاهات الشمالية الغربية للرياح الباردة .

(جـ) خلق منطقتين زراعيتين فى وادى جندالى ووادى الثماح ، ويزرع الوادى بالاشجار لتثبيت الارض فى المنطقة ، كما يجب عمل فاصل من الاحزمة الخضراء الخفيفة بين المنطقة الصناعية وبقية جسم المدينة .

(د) اختيار شبكة الطرق الرئيسية من المسارات الطبيعية بشكل مشع فى اتجاهات شمال شرق والشمال الغربى بحيث تسمح بأكبر قدر من حركة الرياح ذات الاتجاهات الشمالية الى جسم المدينة .

(هـ) اختيار المناطق المفتوحة بين الكتل العمرانية للمدينة فى اتجاهات الميول الطبيعية للاستفادة من الرياح الادياباتيكية بالتغلغل داخل جسم المدينة اثناء الليل .

(و) الاستفادة من المحاور البصرية التوجيهة الامثل لعناصر المدينة السكنية .

الباب الثالث ـ التوصيات :

لكل موقع عناصرة الطبيعية ومحدداته البيئية والتى تختلف من موقع الى آخر سواء كانت فى الاشكال الطبيعية أو مكونات الطبيعة أو قوى الطبيعية ومحدداتها البيئية مما يجعل كل موقع فريدا فى تكوينه عن أى موقع آخر . وتفرض الطبيعة نفسها على المخطط ويجب على المخطط احترام الطبيعة والتعامل معها واخذها كمعايير اساسية ويتعين عليه أن يقيم البدائل وان يختار البديل الامثل الذى يتوافق مع الطبيعة ومحددات البيئة ويتعين على المخطط عند تخطيط المدينة ان يضع فى اعتباره المحددات البيئية والمعايير التصميمية التالية للتوافق مع الطبيعة وخلق انسجام تام بين الاشكال والعناصر الطبيعية والاشكال والعناصر التى يفرضها على الطبيعة وتتلخص فيما يلى :

ـ تأكيد العناصر الطبيعية بوضع مركز المدينة بمبانيه المرتفعة فى قمم الجبال واستخدام القيعان كمسطحات خضراء زراعية .

ـ يجب المحافظة على مخرات السيول واستخدامها كمناطق ترفية خضراء ومفتوحة وعدم التشييد فى اماكنها ، وتحديد اماكن الفيضانات فى حالة السيول الشديدة واستخدامها كمناطق مفتوحة خضراء .

ـ يجب تحديد مسارات خطوط القمم بالموقع والتى تمثل التوزيع الطبيعى للهضاب المرتفعة وقمم الجبال الجافة بالموقع والتى يمكن واستخدامها كمناطق للخدمات الرئيسية وتأكيد مواقعها عمرانيا وبصريا .

ـ مراعاة تحديد المسارات الطبيعية الملائمة والتى تمتاز بميول قياسية أو عناصر جمالية ممتازة والمحافظة عليها كمسارات للمشارة أو للهيكل العام للطرق المقترح بالموقع .

ـ مراعاة تحديد ملائمة التربة السطحية للاستعمال الزراعى وتنويعها .

ـ مراعاة طبوغرافية الموقع فى التصميم واستخدام اتجاهات الميول فى التوجيه الامثل بالنسبة للموقع وطبوغرافيتة وكذا لعناصر المدينة طبقا لتدرجها مثل تحديد المناطق ذات الميول السهلة ، كمناطق استعمالات من الدرجة الاولى للسكن .

ـ يجب الا تقع الصناعة والسكن على خط ميل واحد ويستحسن وضع الصناعة بعيدة عن السكن وعلى المسطحات الافقية وفصلها عن السكن بفاصل طبيعى مثل مخر سيل .

ـ تأكيد المحاور والمحددات البصرية بالطبيعة واستغلالها كمحاور ومحددات بصرية رئيسية بالمدينة حتى تتجانس المدينة مع الطبوغرافية المتاحة .

ـ استخدام العناصر الطبيعية كالجبال فى صد الرياح الغير مرغوب فيها عن جسم المدينة مثل رياح الخماسين .

ـ توزيع استعمالات الاراضى مما يتناسب مع التربة السـطحية للموقع وتخصـيص التربة السطحية الجافة مثل قمم الجبال والاسـطح المائلة كمناطق تشيد وتنويعها وتخصيص التربة السـطحية التى تحتفظ بالميـاه مثل القيعـان ومخـرات السـيول والوديان كظهـير زراعى للمدينة .

ويتعين على المخطط التأكد من مـدى ملائمة البدائل المقترحة للمحـددات الطبيعية بحيث تحقق تجانس تام مع الطبيعة وعناصرها واشكالها الجذابة وتسخير قواها دون هدم أو تخريب أو مجرد الاقلال من جمالها أو كفائتها حيث انها من صنع الخالق سبحانه وتعالى ولا يستطيع أى انسان ان يخلق مثل هـذا الحـد من الكمال والجمال الطبيعى .

المراجـع

ـ مركـز بحـوث التنميـة والتخطيط والتكنولوجى .

« التخطيط العام لمدينة الامل » .

الهيئة العامة للتخطيط العمرانى (١٩٨٠) .

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معدلات نسبة الاستعمال السكنى لأراضى المدن الجديدة والحالية بجمهورية مصر العربية والمدن العالمية

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مقـــــــدمة :

تعانى جمهورية مصر العربيـــة من الانفجار السكانى ، ومن الزيادة المطردة فى عدد الســكان بما لا يقابله زيادة فى عدد الوحدات السكنية ، والمدن الجديدة واللازمة لامتصاص هذه الزيادة. مما ينتج عنه مشاكل عديدة فى المـــدن القائمة ومنها الخلل فى نسب استعمالات الأراضى وجعل الاستعمال السكنى أعلى نسبة على حساب باقى استعمالات المدن ســواء فى فراغات أو حدائق أو خدمات (تعليمية صحية ــ اجتماعية) . وكذلك على حســـاب النشـــاط الاقتصادى (الصــناعى ــ الزراعى ــ التجــارى) وكانت الأرض الزراعيـــة من العناصر الرئيسية التى تأثرت بالخلل فى نسب اســتعمالات الاراضى فى المدن الحالية . وكذلك كان غيـــاب التخطيط للمدن الحالية من العناصر الرئيسية الاستمرار المشكلة وتضخمها وذلك لعدم وجود تخطيط عام أو اقليمى أو قومى وذلك بالنسبة للمدن الحالية

المشكلة الأخرى تتمثل فى نسب استعمالات الأراضى فى المدن الجديدة فعلى الرغم من عــدم تناسبها مع الزيادة السكانية أو مع الأنشـــطة الاقتصادية أو المسطح الرهيب من الصــحراء الذى يصل الى حوالى ٩٥٠ الف كيلو متر مربع بدون استغلال . حيث نجد ان نسبة الاستعمال التى تصل فى المدن الجديدة ما بين ٤٠ ــ ٦٥٪ وهى نسبة عالية مع الظروف السابق توضيحها . وان كل هذه الظروف والمشـــاكل جعلت من الضرورة الوصول الى معدلات لنسب استعمالات الأراضى وبالاخص العنصر الأساسى والمؤثر وهو السكنى سواء فى المدن والقـــرى الحالية أو الجديدة بجمهورية مصر العربية . كما يهــدف هذا البحث .

أولا ــ اهميــــة الاستعمال السكنى فى المــدن الجديدة والحالية والعالمية :

١ ــ ان الاستعمال السكنى لأراضى المــدن الجــــديدة يمثل النســـــبة الرئيســـية لباقى الاستعمالات . حيث ان نسبته تتراوح ما بين ٣٥ ــ ٦٠٪ وهى النسبة الرئيسية لهذه المدن. وحيث ان السكان هم الهدف الرئيسى لهـــذه المدن واسكانهم ، فنجد ان باقى الاستعمالات التى تتمثل فى الخدمات الاجتماعية (التجارية ــ الاجتماعية ــ الزراعيــــة) مرتبطة بطبيعــة السكان لهذه المدن .

٢ ــ ان السبب الرئيسى لانشـــــاء المــدن الجديدة فى بداية عهدها كان للتقليل من تمركز السكان وأماكن العمل فى المـــدن الكبيرة التى أصبحت تعانى من مشاكل التضخم والتزاحــم والعشوائية وذلك عن طريق انشــاء مجتمعات جديدة ذات ظروف صحية ملائمة بحيث تكون كل منهما وحدة متكاملة اجتماعية (٨) .

٣ ــ الحد من هجرة الســكان الى المــدن القائمة وذلك عن طريق توفير السكن والعمـــل فى المدن الجديدة .

٤ ــ اعادة توزيع السكان على المســـتوى القومى وذلك لتحقيق هـــدف اســـتراتيجى عسكرى واقتصادى انتاجى وأيضا اجتمــاعى لتوفير ظروف معيشة وعمل أفضل

٥ ــ التحكم فى الامتداد العمرانى العشوائى والحفاظ على الميـــزات الطبيعية والبيئيـــة للمجتمع وتحسين الظروف المعيشية للســكان لتلافى الهجرة الغير مرغوبة .

٦ ــ القابلية للتواجد والتنفيــذ من الناحية الاقتصادية وذلك عن طريق الاهتمام بدراســـة كل من القاعدة الاقتصادية التى سوف تقــوم عليها المــــدينة الجــديدة ومعـــدلات النمــو المتوقعة لها .

٧ ــ انعاش الموقع الذى ســوف تقوم فيه المدينة الجــــديدة مما يســـاعد على تقدمها وازدهارها عند انشائها .

٨ ــ أن تنشأ المدينة الجــديدة على أسس تخطيطية تتمشى مع كل من الســياسات القومية والاقليمية والمحلية والمصالح الخاصة وذلك بناء على خطط لتطوير المجتمع من حيث الاســـكان والمواصـــلات والتنمية والترقيـــة والبنيـــة الأساسية وباقى الخدمات .

٩ تحقيق مستوى معيشى جيد ومتميـــز ومتوازن يحتوى على خدمات عامة متكاملة مع التركيز على الخدمات الاجتماعية والاقتصادية.

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١٠ ـ توفير مساكن تفى بمتطلبات كل من ذوى الدخول المحدودة والمرتفعة مما يجعل الانتقال الى هذه المدينة عامل جذب لكل الطبقات الاجتماعية .

١١ ـ ان تكون تلك المدينة مجالا لاستعمال أسس متطورة للتصميم والتكنولوجيا الحديثة من حيث استخدامات الأراضي ومواد البناء وطرق الانشاء ومستوى الخدمات (٩) .

١٢ زيادة الارتباط بالطبيعة والانتماء لها وتأكيد أهمية ذلك فى المدينة الجديدة وذلك عن طريق الاهتمام بتنسيق المواقع والمناطق الخضراء والترويحية .

١٣ ـ تحقيق ذاتية الفرد وتأكيد دوره فى المجتمع وذلك خلال منهاج اجتماعى وطبيعى قوى ومتماسك (١٠) .

ثانيا ـ أنواع المدن الجديدة :

هناك خمسة انواع من المدن الجديدة مصنفة وفقا لكل من حجمها وموقعها وهذه الأنواع الخمس هى : ـ

١ ـ مدن جديدة داخل مدن قائمة :

وهى مجتمعات يتم تنميتها داخل الحدود الحضرية لمدن قائمة (١١) ويتم انشائها اما فى مناطق مهجورة أو فى المناطق المراد اعادة تنميتها والغرض منها هو اعادة احياء مراكز قائمة وتلافى الامتداد العمرانى فى غيبة تمدد المركز الحضرى للمدينة (٩) .

٢ ـ مراكز نمو عمرانى جديدة:

هى مجتمعات صغيرة فى المناطق الريفية لها امكانية النمو والتحول الى مراكز حضرية اكبر وذلك بتخطيط مسبق هدفه تلافى الهجرة الى الحضر (١٢) ، وهى ليست مدن جديدة تخضع للتعريف المعتاد بل يمكننا ان نعتبرها اما جزء من مدينة جديدة كبيرة الحجم أو ضاحية نمو تقليدية (١١) .

٣ ـ المدن القائمة بذاتها :

هى مدن مكتفية ذاتيا تحتوى على كافة العناصر والانشطة والخدمات اللازمة لقيامها (١٢) وتقع بعيدا عن المدن القائمة فى اماكن تسمح امكاناتها الطبيعية (١١) والاقتصادية بذلك وهذا النوع من المدن الجديدة يجب أن يخدم الاقليم الذى يقع فيه ويتم توزيعه وانشاؤه على ضوء دراسة وخطة قومية شاملة (٩) .

٤ ـ المدن التابعة :

هى اكثر أنواع المدن الجديدة انتشارا حيث تعتبر المدينة من هذه النوعية كوكب يدور فى فلك مدينة رئيسية ويكون قريبا منها . وتعتبر المدينة التابعة (من الناحية الاقتصادية) جزء لا يتجزأ من الكيان الحضرى الاقليمى للمدينة الرئيسية ، وان كانت المدينة التابعة (من الناحية الطبيعية) منفصلة عن هذا الكيان (١٣) . ولذا فيجب أن تكون متوازنة من حيث اعتبارات أو مقاييس تتعلق بكيانها الاقتصادى وموقعها من المدينة الاساسية (١٠) . ويكون الهدف من قيامها هو تلافى تمركز كل من السكان والعمالة فى منطقة حضرية كثيفة يزداد نموها على حساب باقى المدن الأخرى (١٤) .وكذلك لتخفيف الحمل عن المدينة الأساسية من حيث الزحام وتشجيع الصناعة والتجارة على الخروج من المناطق الكثيفة وعلاج باقى امراض المدن الكبرى (١٥). وتتناسب درجة تبعية هذه المدن الجديدة للمدينة الأم مع المسافة بينهما وسهولة المواصلات من احداهما للاخرى (١٦) .

ثالثا ـ الاستعمال السكنى بالمدن الجديدة بجمهورية مصر العربية :

١ ـ مدينة العاشر من رمضان :

تقع مدينة العاشر من رمضان عند الكيلو ٥٥ من القاهرة ويبلغ عدد السكان المتوقع حتى سنة ٢٠٠٠ حوالى ٥٠٠ ألف نسمة ، وتعتبر من أولى المدن الجديدة فى جمهورية مصر العربية لامتصاص الزيادة السكانية بالقاهرة والمدن الرئيسية المجاورة لها .

ويبلغ نسبة الاستعمال السكنى بها ٦٧ ٪ (٦) بما يوازى ٥٠٤٢ هكتار وهى نسبة عالية جدا بالنسبة لكونها مدينة صناعية انظر الشكل رقم (١) (جدول رقم / ٣) . انظر الشكل رقم (٩) والجدول رقم (١) .

٢ ـ مدينة السادات :

تقع مدينة السادات عند الكيلو ٩٣ من مدينة القاهرة على الطريق الصحراوى وهى مدينة تتوسط بين القاهرة والاسكندرية شمالا وجنوبا وكذلك الدلتا شرقا ووادى النطرون غربا وتعتبر فى موقع تخطيطى مناسب حيث انها تعتبر كنواة لجذب الزيادة السكانية من الدلتا والقاهرة والاسكندرية ويبلغ عدد سكانها المتوقع حتى سنة ٢٠٠٠ حوالى ٥٠٠ الف نسمة . وتبلغ نسبة الاستعمال السكنى بها ٥٠٪ بمسطح ٦٢٥٠ هكتار (٧) وهى نسبة تعتبر أقل من العاشر من رمضان ولكنها مازالت عالية بالنسبة لكونها صناعية وكذلك بالنسبة للمعدلات العالمية (انظر الشكل رقم ٢) والجدول رقم / ٣ .

٣ ــ مدينة العامرية الجديدة :

تقع مدينة العامرية الجديدة على بعد ٤٥كم من مدينة الاسكندرية (٦) وبجوار الجزء الشمالى الغربى للدلتا ــ وسيبلغ عدد سكانها المتوقع فى سنة ٢٠٠٠ حوالى ٥٥٠ الف نسمة. وتعتبر مدينة مناسبة لامتصاص الزيادة السكانية من مدينة الاسكندرية والمناطق المجاورة واستيعاب الصناعات الجديدة المطلوبة حسب استثمارات المنطقة ويبلغ نسبة الاستعمال السكنى بها ٤٧ ٪ بما يوازى ٥٩٤٦ هكتار (انظر الشكل رقم / ٩) (والجدول رقم / ٣) .

٤ ــ مدينة العبور :

تقع على بعد ٣٠ كم من القاهرة على الطريق الواصل بين القاهرة وبلبيس وجارى تنفيذها وخططت على اساس يصل عدد سكانها سنة ٢٠٠٠ الى ٢٥٠ الف نسمة ويمكن زيادته الى ٥٠٠ ألف نسمة وسوف يبلغ نسبة الاستعمال السكنى لهذه المدينة ٤٤٪ من اجمالى مسطح المدينة .

وهدف هذه المدينة توفير الاسكان للعاملين بمنطقة الخانكة بالاضافة لامتصاص جزء من الزيادة السكانية بالقاهرة والمناطق المجاورة لها (أنظر الشكل رقم / ٩) (انظر الجدول رقم / ٣) .

٥ ــ مدينة الامل :

تقع مدينة الامل على بعد ٤٠ كم من القاهرة عن طريق القطامية المعادى وهى على هضبة ترتفع حوالى ٢٠٠ متر عن سطح البحر (٦) . وسوف يبلغ عدد سكان هذه المدينة سنة ٢٠٠٠ حوالى ٢٥٠ الف نسمةويبلغ نسبة الاستعمال السكنى لهذه المدينة ٣ر٥٦ ٪ (٧) بمسطح ٨١٠ هكتار . وهدف هذه المدينة اسكان السكان القائمون على الصناعة وامتصاص جزء من سكان القاهرة . (انظر الجدول رقم / ٣) .

٦ ــ مدينة نصر :

تقع مدينة نصر فى الشمال الشرقى لمدينة القاهرة وتقع على مساحة قدرها ١٨٠٧ هكتار ويمثل الاستعمال السكنى بها ٢٦ ٪ (٧) . بالنسبة لباقى الاستعمالات وبمسطح ٤٧٢ هكتار . وهدفها هو امتصاص جزء من الزيادة السكانية لمدينة القاهرة .

٧ ــ مدينة حلوان الصناعية :

تقع بالقرب من مدينة حلوان من اجل امتصاص العمال الموجودين بالمصانع المجاورة بدلا من الرحلة اليومية التى كانت تتم الى القاهرة وبالعكس والتخفيف على مدينة القاهرة ويبلغ عدد السكان بها ١٥٠ الف نسمة ونسبة الاستعمال السكنى ٣٧ ٪ بمسطح٣٨٣ هكتار(٧) انظر الجدول رقم / ٣) .

٨ ــ مدينة هليوبوليس الحى السادس :

تقع شمال شرق مدينة القاهرة وهدفها امتصاص الزيادة السكانية من مدينة القاهرة ويبلغ عدد سكانها ٣٠ الف نسمة ونسبة الاستعمال السكنى ٤٢٪ بمسطح ٥٧١ هكتار (٧) (انظر الجدول رقم / ٣)

٩ ــ مدينة ٦ اكتوبر :

تقع مدينة ٦ اكتوبر على بعد حوالى ٣٢كم من مدينة القاهرة فى الطريق الواصل بين القاهرة والواحات على هضبة ترتفع ما بين ١٨٠ ــ ١٩٠ متر فوق سطح البحر .

وتعتبر مدينة تابعة للقاهرة مما يزيد من مشاكل الانتقال من والى القاهرة وسيبلغ عدد سكانها المتوقع فى سنة ٢٠٠٠ حوالى ٥٥٠ الف نسمة . وتبلغ نسبة الاستعمال السكنى لهذه المدينة ٥٠٪ بمسطح ١٩٠٠ هكتار .

رابعا ــ الاستعمال السكنى بالمدن العالمية :

تعتبر المملكة المتحدة من الدول الرائدة فى انشاء المدن الجديدة وذلك بناء على تخطيط اقليمى مسبق . حسب الأنشطة الاقتصادية والزيادة السكانية المتوقعة . حيث قامت ببناء حوالى ٩ مدن حول مدينة لندن لامتصاص الزيادة المتوقعة لاقليم لندن وأصبحت مدن تابعة للاقليم وبها خدمات مركزية مستقلة وتعتمد على لندن فى الخدمات الاقليمية فقط . ووصل الاستعمال السكنى بمدينة هارلو ٣٦ ٪ بالنسبة لباقى مسطح المدينة وكذلك ٣٠ ٪ بالنسبة لمدينة كراولى . وتعتبر نسب متناسبة مع عدد السكان ونسب الاستعمالات الأخرى والخدمات وطبيعة المدن .

وقد قامت المملكة المتحدة باقامة حوالى ١٤ مدينة أخرى فى كلا من :

(ويلز ــ المنطقة الشمالية الغربية ــ اسكتلاندا المنطقة الشمالية الشرقية المنطقة الوسطى) .

وكان توزيع هذه المدن على مستوى الاقاليم وحسب الاحتياج لامتصاص الزيادة السكانية فى هذه الاقاليم وكذلك لخدمة الصناعات والانشطة الأخرى والحفاظ على نسب استعمالات الاراضى فى المدن الاصلية .

فنجد ان نسبة الاستعمال السكنى فى كروبى هو ٧٠٤٨ ومدينة ويددتش ٣٨ ٪ ومدينة كومبرنالد ٤١ ٪ (انظر الجدول رقم / ٢) .

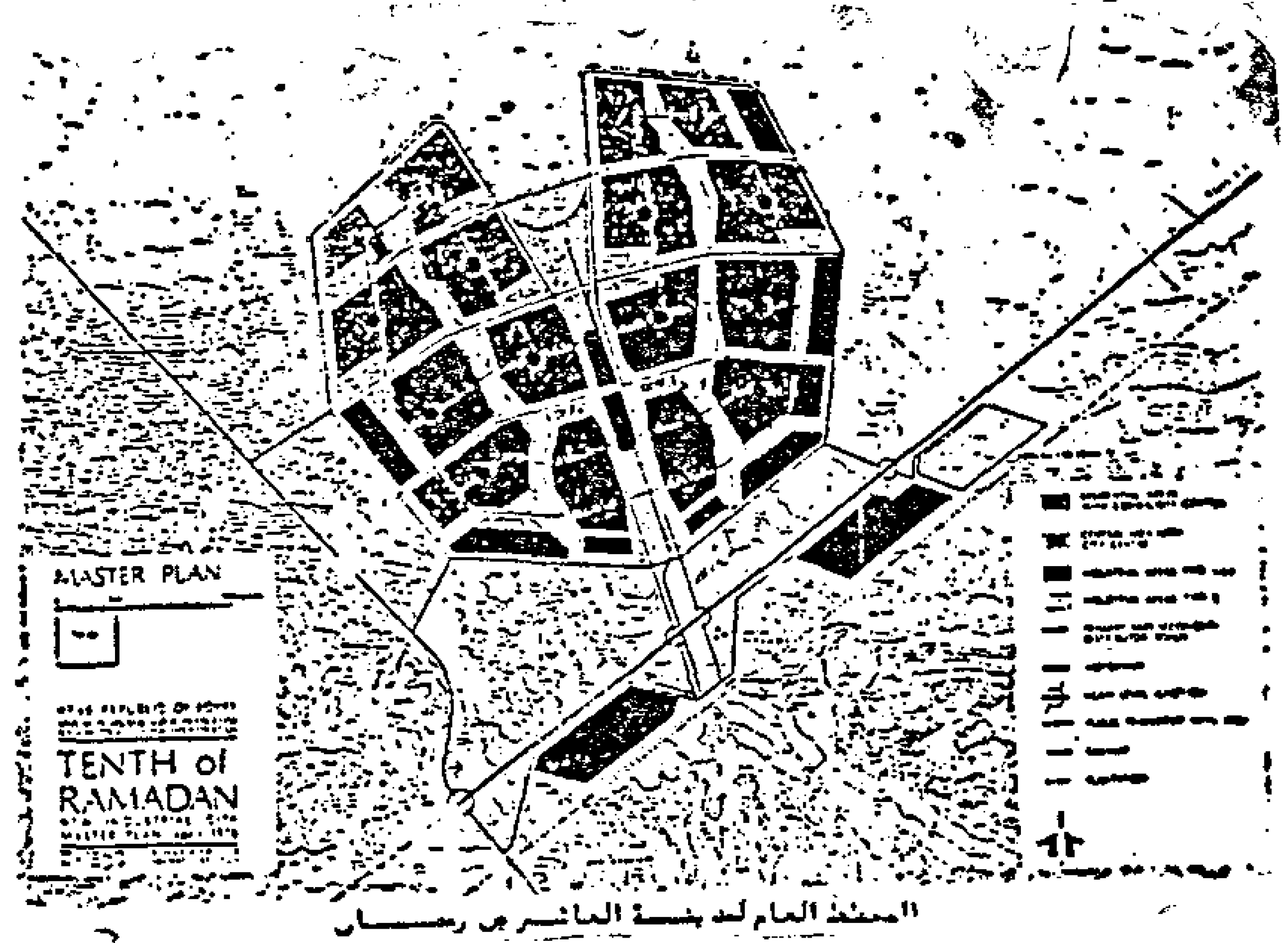
وبذلك يكون متوسط نسب الاستعمال السكنى فى بعض مدن المملكة المتحدة يكون ما بين ٣٠ ٪ ، ٥٥ ٪ وهى نسبة مناسبة تبعا لطبيعة نشاط المدينة سواء كانت (تجارية ــ صناعية ــ سكانية ــ صيد ــ سياحية) فكل نشاط وطبيعته يؤثر فى نسبة الاستعمالات .

نسبة الاستعمال السكنى فى المدن السياحية يخالف المدن الصناعية ــ المدن التجارية .

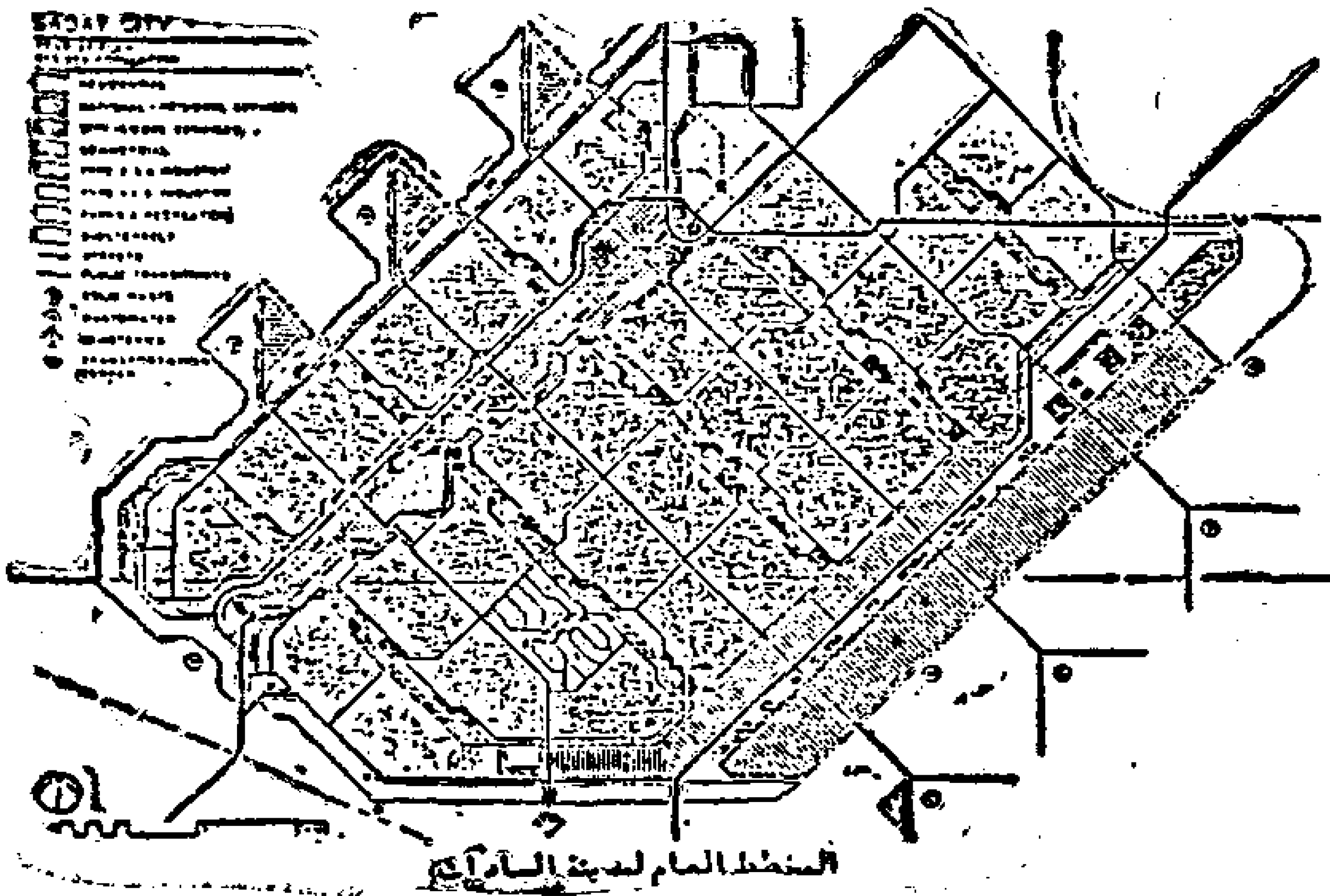
(انظر الجدول رقم (٢) والشكل رقم ٤ ، ٥ ، ٦ ، ٧ ، ٨ ، ٩) .

خامسا ــ الاستعمال السكنى بالمدن الحالية بجمهورية مصر العربية :

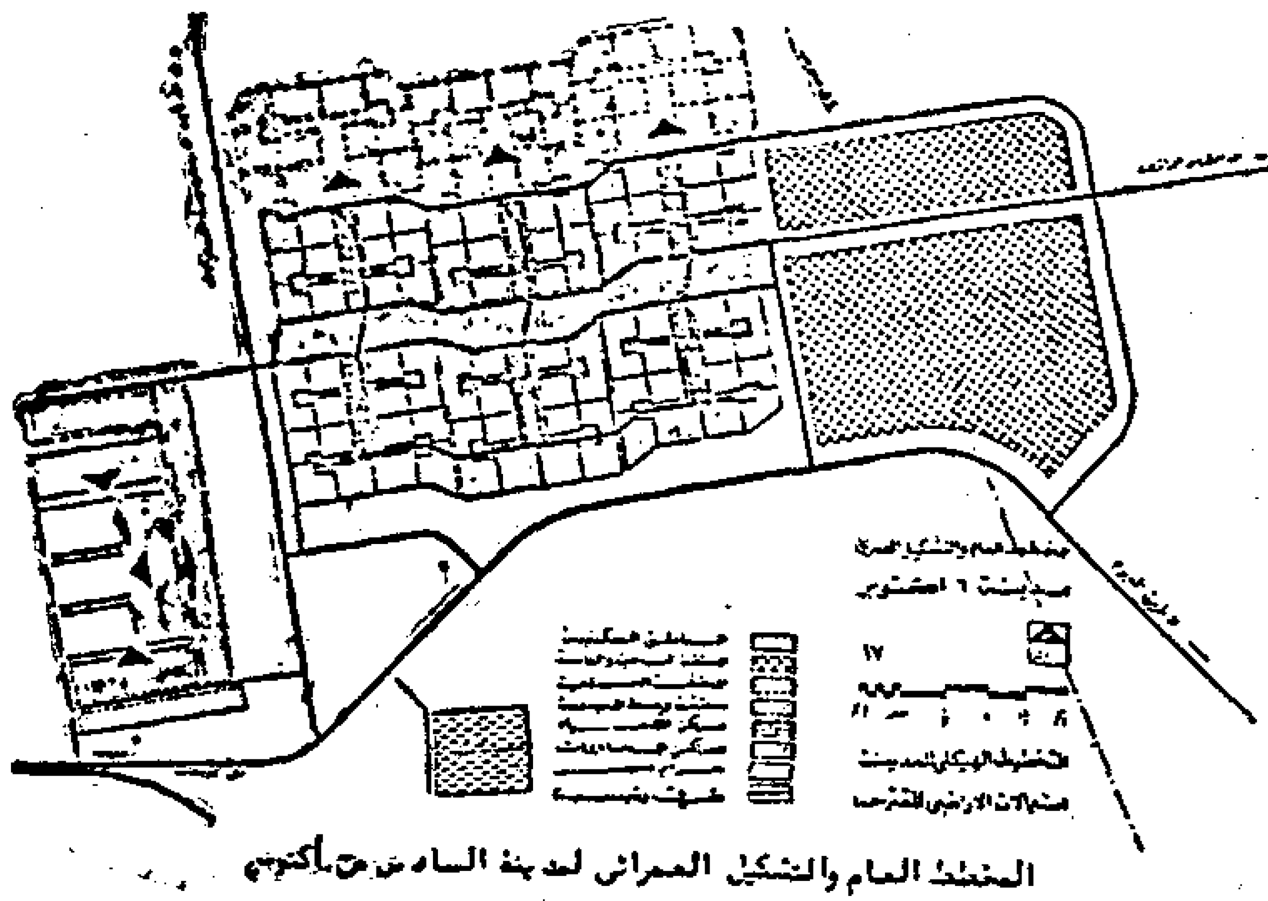
ان الاستعمال السكنى فى مدن وقرى جمهورية مصر العربية يمثل النسبة الكبرى بالنسبة لباقى الاستعمالات وذلك لان هذه المدن قام معظمها بدون تخطيط مسبق مما جعل هناك خلل فى نسب استعمالات الاراضى والنسب العالمية والتخطيطية .



شكل رقم ١



شكل رقم ٢



شكل رقم ٣

نماذج من المدن الجديدة بجمهورية مصر العربية « أ »

١ ــ جهاز مدينة العاشر من رمضان .
٢ ــ جهاز مدينة السادات .
٣ ــ جهاز مدينة السادس من اكتوبر .

(جدول رقم ١) نسبة الاستعمال السكنى بالمدن الجديدة بجمهورية مصر العربية .

اسم المدينة	مدينة ١٠ رمضان	مدينة الامل	السويس	السادات	٦ اكتوبر	العامرية	بور سعيد	حلوان	مدينة نصر	١٥ مايو	العبور
نسبة الاستعمال السكنى ٪	٦٧	٦٥	٥١	٥٠	٥٠	٤٧	٣٩	٣٧	٢٦	٢٢,٧	٤٤

(جدول رقم / ٢) نسبة الاستعمال السكنى فى بعض المدن الجديدة العالمية (٧) .

اسم المدينة	رون كورن	كوربى	هات فيلد	ولهيد ين جاردن	بيترلى	ريد تشر	كراولى	باسيلد ون	همل هيمبستد	هارلو	
نسبة الاستعمال السكنى ٪	٣٤	٤٨	٥٥	٤٥	٤٠	٣٨	٣٠	٣٢	٥٣	٣٦	

(جدول رقم / ٣) نسبة الاستعمال السكنى فى بعض مدن الجمهورية

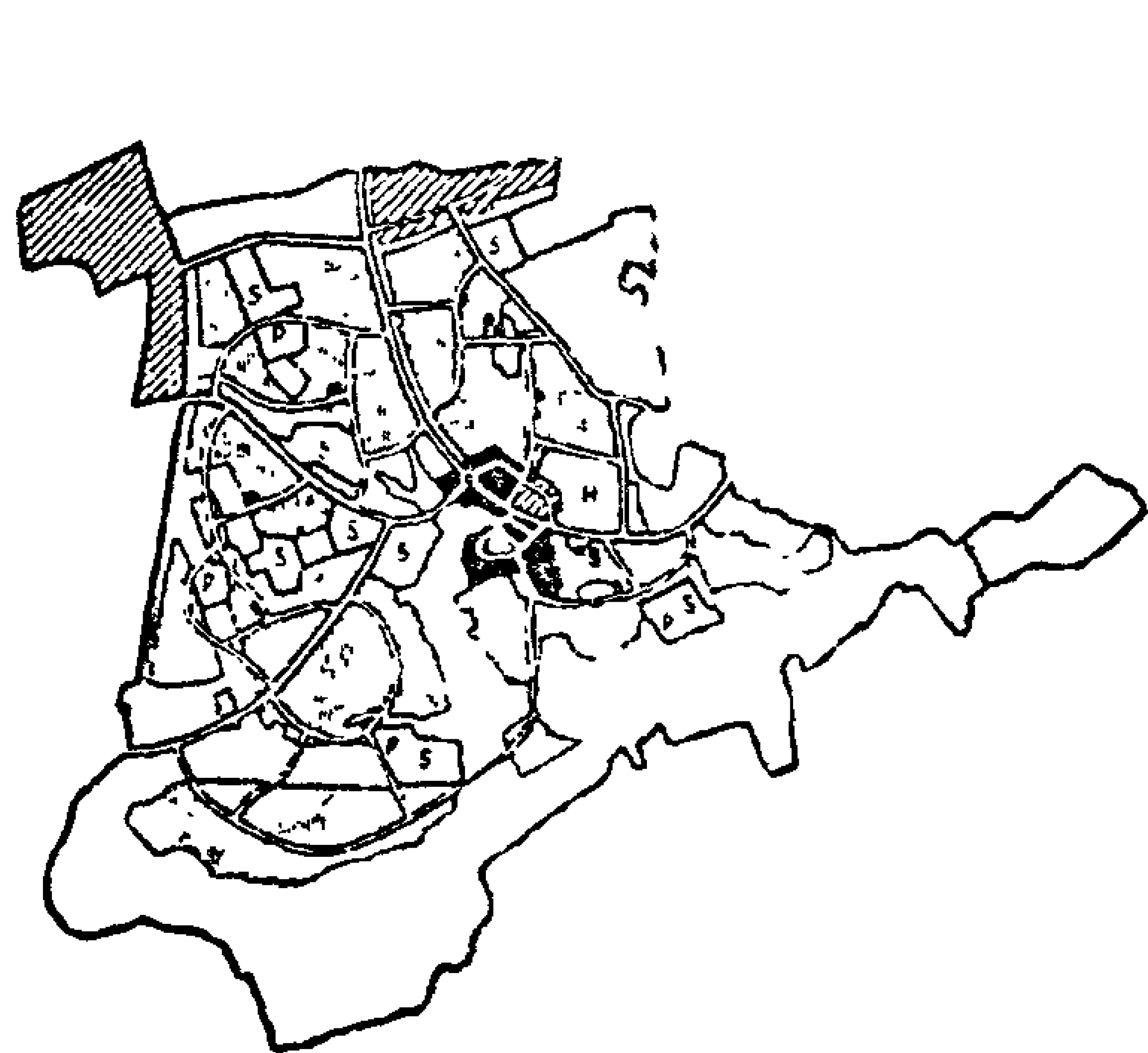
اسم المدينة	الزقازيق	اسوان	مرسى مطروح	العريش	منوف	دمياط	قليوب	السنطة	المنيا	بلطيم
نسبة الاستعمال السكنى ٪	٤١	٥٧	٥٤	٦٣	٧٢	٦٧	٥٨	٦١	٤١	٤٥

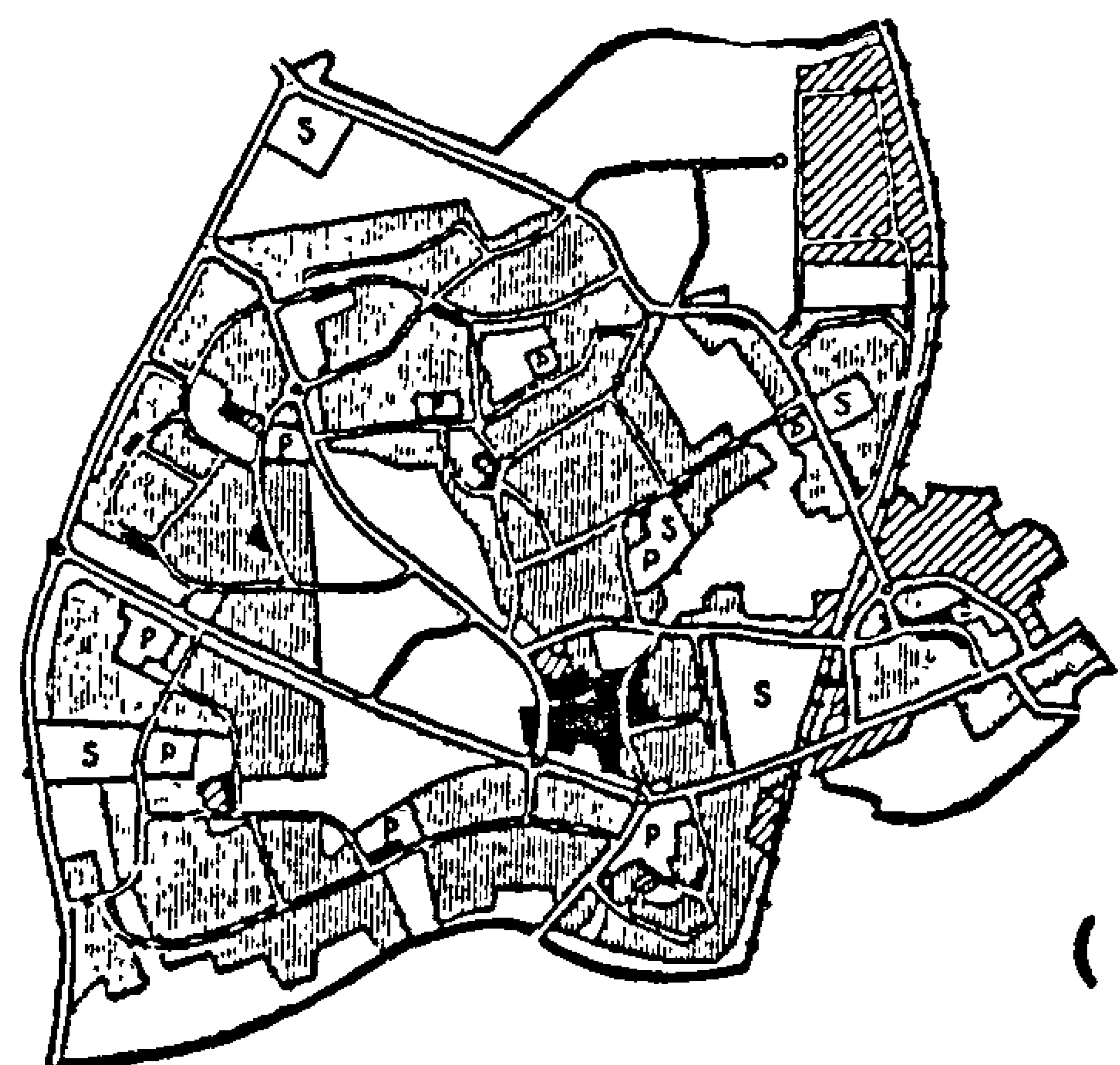
* تم حسابها وحصرها بواسطة الباحث من استعمالات أراضى هذه المدن سنة ١٩٨٠ وسنة ١٩٨٥ .

Residential
Existing Industry
Industrial Area with Special Control
Proposed Industry
Town Centre and Local Centres
Urban Motor-road
Rapid Transit Route
Secondary Schools
Churche
First Housing and Industrial Areas
N
OUTLINE PLAN
Scale of Miles
0 ¼ ½ ¾ 1

MANCHESTER SHIP CANAL
RIVER MERSEY
ASTMOOR
PARK
NORTON PRIORY
ICI
MOORE
DARESBURY
TOWN PARK
Town Centre
PARK
HOSPITAL
PRESTON BROOK
NORTH CHESHIRE MOTORWAY
SUTTON WEAVER
WEAVER NAVIGATION
WEAVER CANAL
RIVER

RUNCORN شكل رقم (٤)





شكل رقم (٥)

RESIDENTIAL
INDUSTRY
TOWN CENTRE NEIGHBOURHOOD CENTRES AND SUB-CENTRES
OPEN SPACE AND AGRICULTURAL LAND
MAJOR ROADS
RAILWAYS
SCHOOLS-PRIMARY
SECONDARY
HOSPITALS
N
OUTLINE PLAN
Scale of Miles
0 ¼ ½ ¾

— PETERLEE

شكل رقم (٦)

RESIDENTIAL
INDUSTRY
TOWN CENTRE NEIGHBOURHOOD CENTRES AND SUB-CENTRES
OPEN SPACE AND AGRICULTURAL LAND
MAJOR ROADS
RAILWAYS
SCHOOLS PRIMARY
SECONDARY
HOSPITALS
N
OUTLINE PLAN
Scale of Miles
0 ¼ ½ ¾ 1

CORBY

نماذج من المدن الجديدة العالمية ـ ٢ .

والمشكلة تزداد بمرور الوقت نظرا لزيادة السكان الهائلة والتى لم يقابلها انشاء مدن جديدة حيث يكون التكدس فى نفس المدن على حساب الكثافة السكانية أو الاراضى الزراعية أو الخدمات سواء فى الطرق أو فى الحدائق أو فى المنافع العامة . حيث نجد ان نسبة الاستعمال السكنى فى مدينة الزقازيق بمحافظة الشرقية عام ١٩٧٥ كانت ٢٨٫٣ ٪ وارتفعت نسبته عام ١٩٨٠ الى : ٤٠٫٥٤ ٪ وكذلك نسبة الاستعمال السكنى بمدينة المحلة الكبرى بمحافظة الغربية كانت عام ١٩٧١ (٣٦ ٪) وأصبحت عام ١٩٨٢ (٤٤٫٦ ٪) بالنسبة لمسطح المدينة . وهذا يدل على ان الخلل فى نسب استعمالات الاراضى هو فى الزيادة السكانية التى لا تكون على أساس تخطيط مسبق ولكن تكون على حساب باقى الاستعمالات الأخرى الهامة لسكان المدينة وكذلك على حساب النشاط الاقتصادى الذى يقوم به السكان سواء كانت أرض زراعية أو خدمات . ونسبة الاستعمال السكنى فى المدن الحالية عالية جدا ، فنجد أن النسبة تصل فى مدينة منوف الى ٧٢ ٪ من اجمالى مسطح المدينة وفى مدينة دمياط ٦٦٫٨ ٪ وفى مدينة أسوان ٥٦٫٧ ٪ ومدينة قليوب ٥٨ ٪ . انظر الجدول رقم / ٣ والشكل رقم (١ ، ٢ ، ٣ ، ٩) .

سادسا ــ التوصيات :

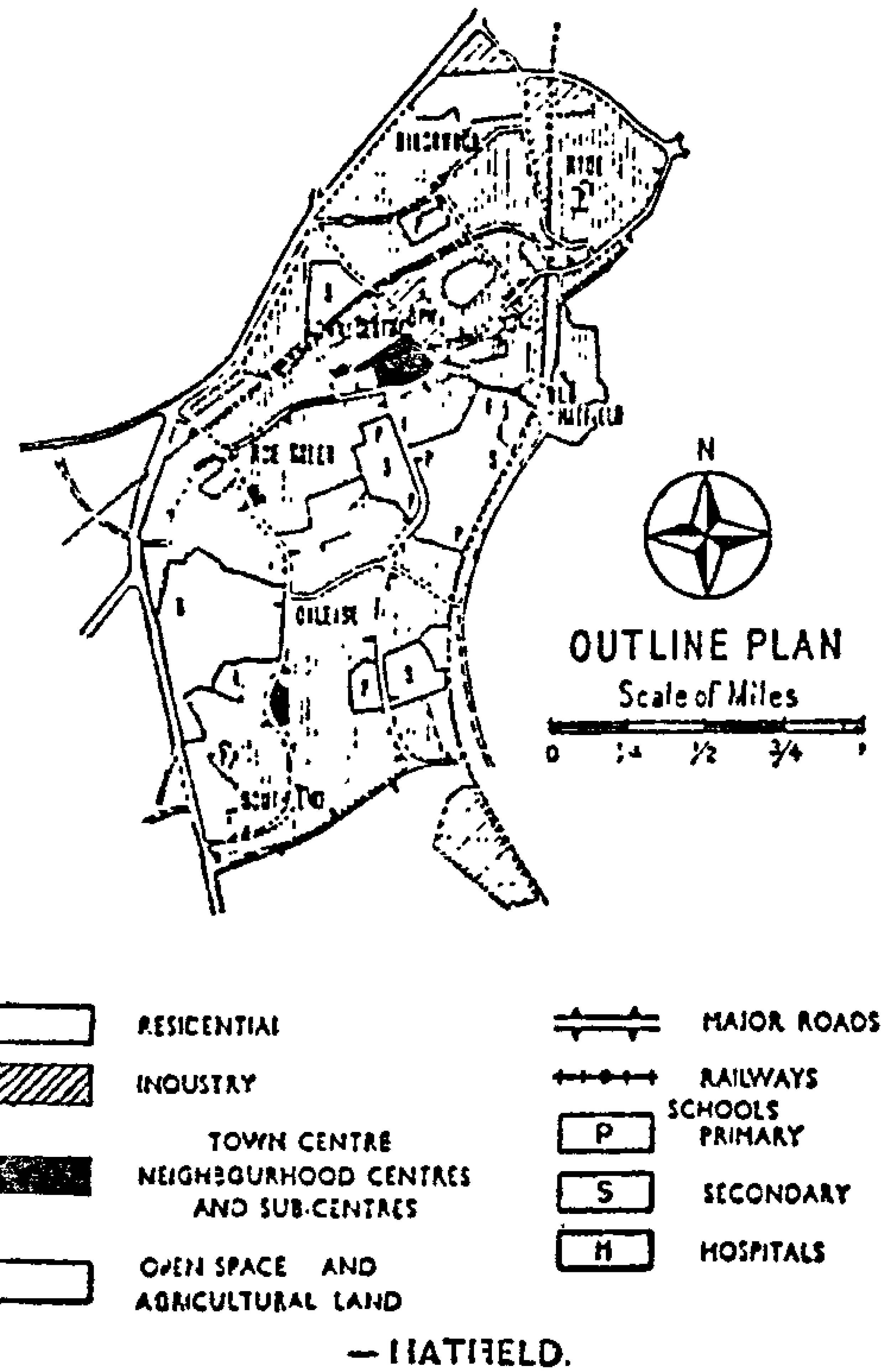
١ ــ نسبة الاستعمال السكنى فى المدن الجديدة بجمهورية مصر العربية :

(أ) ان يكون تخطيط المدن الجديدة وفق تخطيط قومى شامل حيث يحدد عدد وطبيعة سكان المدن الجديدة .

(ب) ان تحدد نسبة الاستعمال السكنى حسب عدد السكان وحسب المخطط العام للمدينة وان يتراوح ما بين ٣٠ ــ ٥٠ ٪ من باقى الاستعمالات كحد أقصى أو حسب نوع نشاط المدينة وطبيعة سكانها . كل هذا يتحكم فى النسبة السكنية المناسبة .

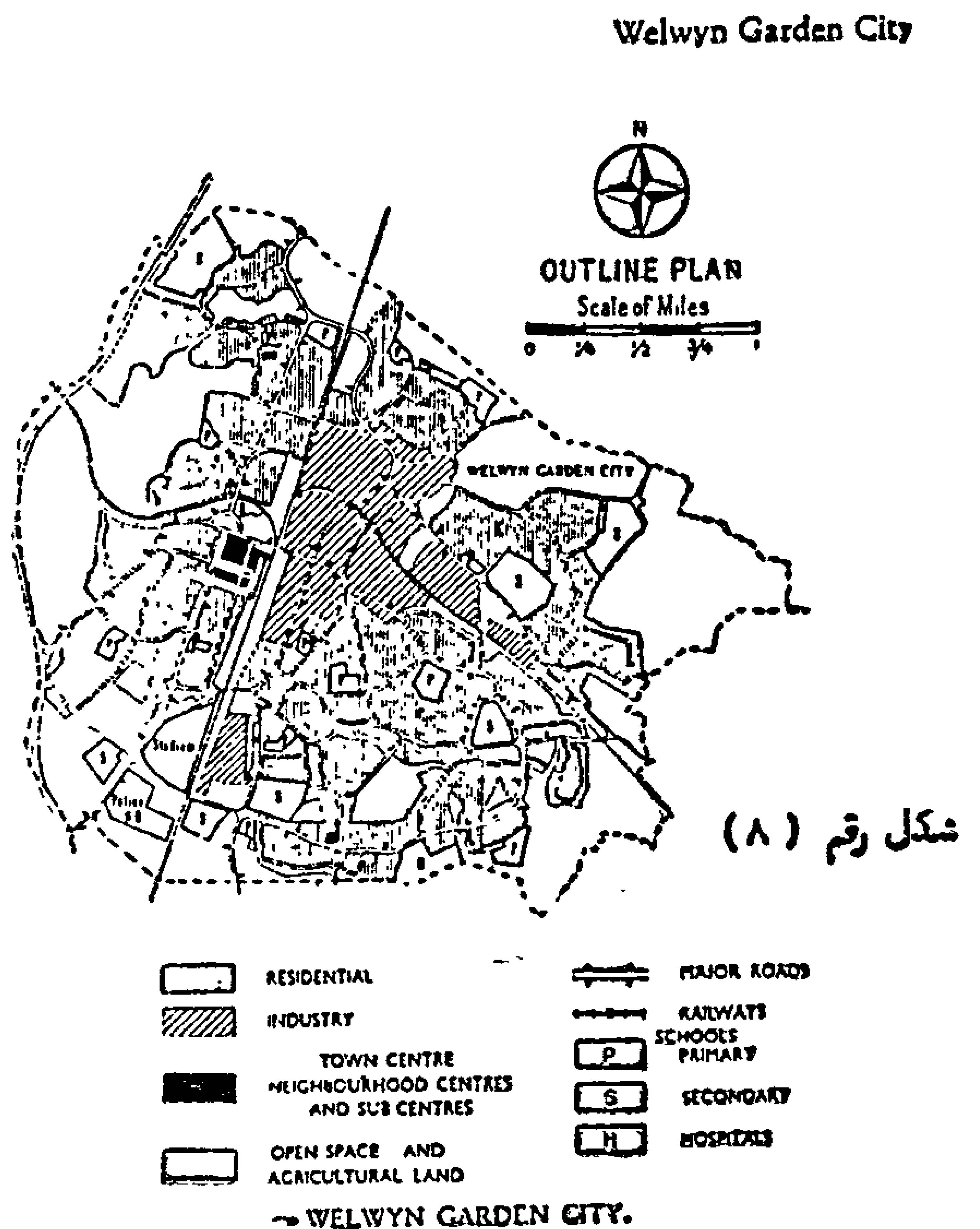
(جـ) ان يكون الامتداد افقيا فى الصحراء ونابع من هدف تعمير الصحارى والتوسع فيها . وليس التكدس السكنى الموجود حاليا بالمدن الجديدة لتوفير شبكات المرافق وخدمات الطرق وخلافة .

(د) التوسع فى انشاء المدن الجديدة لامتصاص الزيادة الكبيرة فى عدد سكان الجمهورية وان تتناسب نسبة الاستعمال السكنى مع باقى استعمالات المدينة حسب المعدلات المصرية والعالمية .



شكل رقم (٧)

Welwyn Garden City



شكل رقم (٨)

نماذج من المدن الجديدة العالمية

(هـ) ان تتناسب باقي استعمالات المدينة مع الاستعمال السكني لتوفير الراحة والصحة لسكان المدن الجديدة وتكون بمثابة حافز جذب من المدن المكدسة بالسكان .

(و) ان تكون المناطق السكنية بالمدن الجديدة وحدة تخطيطية متكاملة مرتبطة لا يفصلها طرق سريعة أو عوائق أو صناعات وتكون نسبها متناسقة مع حجم الخدمات العامة والحدائق والفراغات وسهولة الوصول والانتقال .

النسبة المئوية

٪٩٠ ٪٨٠ ٪٧٠ ٪٦٠ ٪٥٠ ٪٤٠ ٪٣٠ ٪٢٠ ٪١٠

نماذج من المدن الجديدة العالمية — نماذج من المدن الجديدة بمصر — نماذج من المدن المصرية الحالية

نسبة الاستعمال السكني لنماذج من المدن الجديدة والحالية بجمهورية مصر العربية وبعض المدن العالمية

٢ ـ نسبة الاستعمال السكنى فى المدن الحالية :

(أ) عمل تخطيط عام بجميع مدن الجمهوريه واعادة توزيع السكان حسب الانشطة الاقتصاديه ومن خلال تخطيط اقليمى وقومى شامل .

(ب) ضرورة خفض نسبة الاستعمال السكنى فى المدن الحالية وخاصه فى وادى النيل عن طريق انشاء المدن الجديده لامتصاص الزيادات الحالية .

(جـ) ايقاف زيادة المناطق السكنية عن طريق الاعتداء على الاراضى الزراعيه والامتداد عليها .

(د) يجب ان تكون نسبة الاستعمال السكنى فى المدن الحالية معتمدة على طبيعة النشاط الاقتصادى . ونوع المدينة بما لا يتعدى النسب المناسبة لهذه المدن .

(هـ) عمل تخطيط واحلال للمناطق القديمة والرديئة التى تصل فى معظم المدن الى حوالى ٤٠ ـ ٦٠ ٪ من المدن الحالية مما يساعد على اعادة حسابات نسبة الاستعمال السكنى وزيادة الخدمات للسكان والمناطق الخضراء .

(و) الحفاظ على الكثافة العامة للمدن الحالية وتخفيض الزائد منها عن طريق انشاء مدن جديدة لجذب الزيادة الحالية والمتوقعة من المدن القائمة .

(ز) التوصل بمعدلات ثابتة لنسب استعمالات الاراضى للمدن الحالية وحسب نوعيتها والنشاط القائم وكذلك المدن الجديدة فى اطار تخطيط عام نابع من تخطيط اقليمى وقومى شامل .

المراجع

اولا ـ المراجع العربية :

١ ـ أ.د احمد امين مختار استراتيجية المدن الجديدة .

٢ ـ أ.د احمدامين مختار التخطيط للحد من النمو العشوائى يناير ١٩٨٦ .

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٧ ـ هيئة المجتمعات العمرانية الجديدة (مدينة السادات ـ العاشر من رمضان ٦ أكتوبر) .

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أثر التكنولوجيا فى تشييد المساكن بالدول النامية

دكتور مهندس / شريف عبد الرؤوف البنانى *

الخلاصة :

من الضرورى توفير المساكن ذات التكلفة الاقتصادية فى الدول النامية التى تعانى من زيادة عدد السكان . وبتطبيق التكنولوجيا يمكن الحد من استهلاك الطاقات . وفيما يلى مقترحات مفصلة لاختيار المناسب منها فى الدول النامية حيث يوضح كلا منها كيفية استغلال المواد الخام المتاحة بأقل تكلفة .

مشكلة الاسكان

من اهم المشكلات التى تواجه الدول النامية هى أزمات الاسكان التى أصبحت ملموسة بشكل واضح فى المدن والتى امتدت آثارها فى القرى ـ ونتيجة لذلك انتشرت ظاهرة ازدياد الأحياء الشعبية والاستيلاء على الأراضى بوضع اليد بمعدل سريع .

ومن المعوقات التى قللت من تشييد المساكن بالاعداد المطلوبة التى تفى بحاجة السكان تكاليف البناء الباهظة وقلة مواد البناء .

لذلك كان ولابد من اتخاذ خطوات ايجابية للاستفادة من الخامات المحلية ، وانتاج مواد للبناء من مصادرها الطبيعية واستخدام التكنولوجيا لتقليل تكاليف عملية البناء والتشييد .

اهمية الاستفادة من التكنولوجيا

من المؤكد انه يمكن الاستفادة من استخدام التكنولوجيا واستغلال الخامات المحلية فى استنباط وسائل وطرق مختلفة للبناء لكل منطقة بماياتى :

١ ـ تطوير طرق ووسائل البناء المحلية والتى سبق نجاحها فى مناطق اخرى .

٢ ـ استخدام التكنولوجيا مع طرق البناء المطورة والمطبقة فى المناطق الأخرى بنجاح .

٣ ـ الاستفادة من التجديد والابتكار فى تطوير الأساليب نتيجة للبحوث العلمية .

٤ ـ تطوير تطبيق الوسائل التقليدية من خلال تحديث التطبيق وتغيير بعض الأساليب نتيجة استخدام التكنولوجيا .

التكنولوجيا والاسكان

قسمت الجمعية العالمية للاسكان The National Building Organization نماذج أولية للمساكن رخيصة التكلفة ، كما قامت بعرض عديد من الأمثلة لمشاريع الاسكان فى مناطق مختلفة من بعض الدول النامية سواء فى المدن أو فى القرى وكل منها يبين كيفية الاختيار الصحيح للأساليب التكنولوجية المناسبة التى تستهدف الحفاظ على الطاقة المستهلكة والاقتصاد فى المواد الخام المستخدمة فى عملية البناء . وتشترك مشاريع الاسكان المختلفة فى الاستغلال الامثل للمواد الخام المحلية واستنباط وسائل مختلفة ومدنية لاتمام عملية البناء .

ولقد اكدت الجمعية العالمية للاسكان N.B.O. على الاستفادة من استخدام التكنولوجيا فى توفير الطاقة المستهلكة فى الاسكان الاقتصادى والتى سبق تطبيقها فى مناطق مختلفة من الدول النامية على نطاق واسع وتشمل الآتى :

١ ـ المنازل المبنية بالطين

تبنى جدران بعض البيوت فى بعض المناطق من الطين والأسقف من القش وهذه البيوت دائما ما تحتاج الى اصلاحات بل ويعاد بناؤها اكثر من مرة نتيجة للعوامل الطبيعية التى تقلل من تماسك الطين .

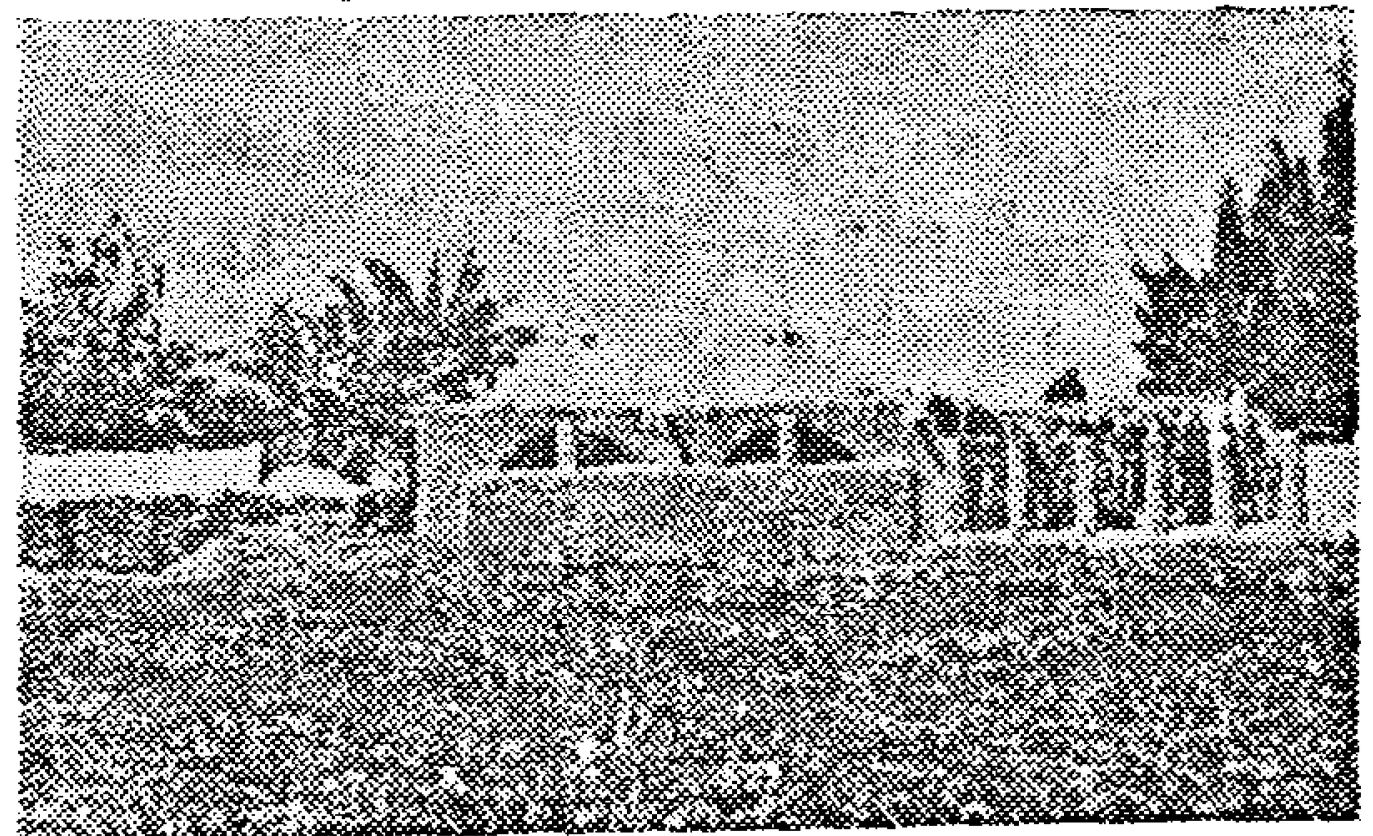
ويجعل هذه الحوائط قوية تبنى من الطوب المجفف بالشمس (الطوب اللبن)

* مدرس بقسم الهندسة المعمارية ـ كلية الهندسة والتكنولوجيا ـ المطرية ـ جامعة حلوان .

ولكن يمكن جعل هذه Sun dried bricks البيوت اكثر تحملا لكل العوامل الطبيعية تبنى من طوب يتكون من خليط الطين والجبس المضاد للمؤثرات الجوية . والذى أقرته الجمعية العالمية للاسكان N. B. O ويحضر خليط الطين والجبس من ٩٥ ٪ طين وجبس ٥ ٪ من معلق البيتومين المضغوط وزيت الكيروسين وشمع البرافين بنسبة ١٠٠ : ٢٠ : ١ .

ولما كانت الأسقف المبنية من القش فى حاجة الى اعادة بنائها بصورة دورية لتصدعها أو لتسوسها باستمرار وهذا غير تعرضها للحريق العشوائى لذلك فباستخدام التكنولوجيا والوسائل المطورة والذى سبق استخدامها فى بناء الحوائط يمكن تطبيقها كذلك فى بناء الأسقف باستخدام خليط الطين والجبس المضاد للعوامل الجوية ــ ثم ترش جميع الحوائط والأسقف من الداخل والخارج بالجير .



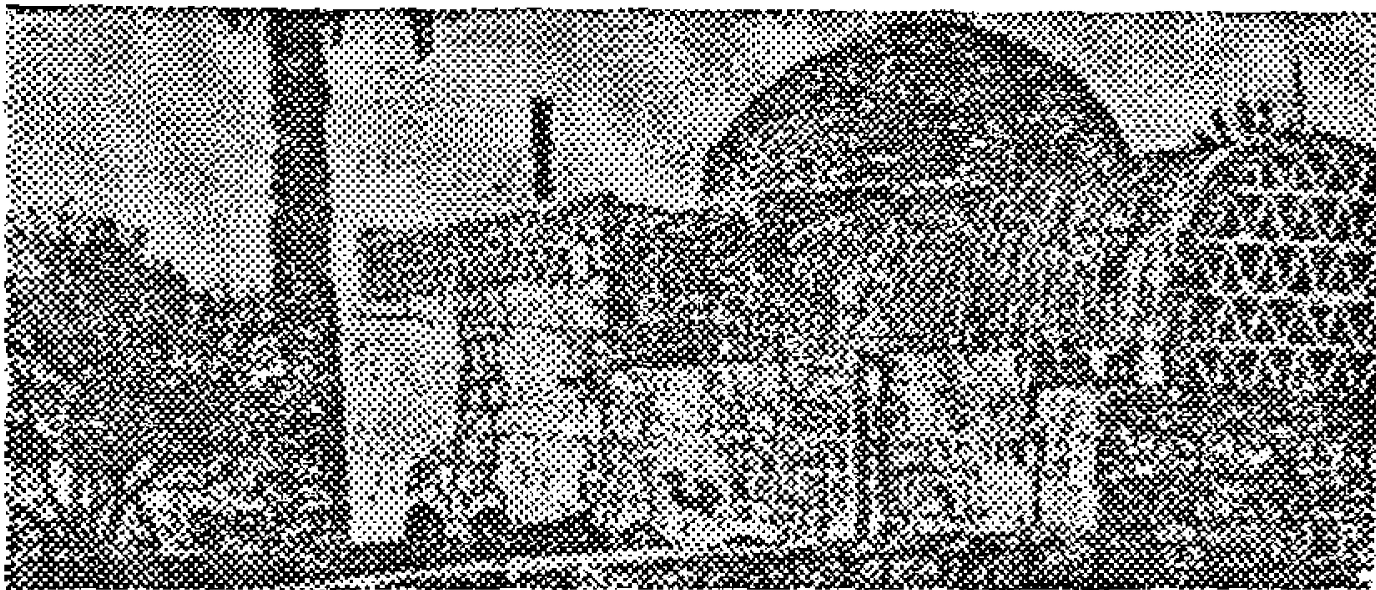


نماذج للمنازل مبنية بالطين

٢ ــ المنازل المبنية من الحجارة

وتوجد فى المناطق القريبة من الجبال الرسوبية ــ ويحصل على الحجارة بتكلفة رخيصة (استخراجا ونقلا) يستفاد من ذلك فى بناء البيوت . فتبنى الحوائط من الحجارة بأشكال مختلفة بينما الأسقف من حجارة على شكل الواح أو شرائح مشربة بالجير . وبناء منزل من طابق واحد أو من طابقين بتكلفة رخيصة يستخدم الدبش فى بناء الحائط بسمك متوسطة ٤٠ ــ ٤٥ سم مع الطين والجير .

وباستخدام التكنولوجيا وطرق البناء المطورة يمكن بناء الحوائط بالحجارة باستخدام خليط من الكتل الحجرية مع الخرسانة الاسمنتية المدعمة بالخشب أو بالحديد ــ فاذا ما تم اعدادها باتقان فان سمك الحائط سيصل الى ٢٠ سم بدلا من ٤٥ سم . وذلك اذا تم تصنيع قوالب أولية (اسطمبا) من كتل البناء الحجرية ــ واستخدام هذه القوالب المصنعة من الحجر سيتيح الفرصة لاستغلال مواد البناء الحجرية المحلية المتاحة بتكلفة رخيصة . ويستخدم فى بناء الأسقف الواح حجرية أطوالها مساوية لطول الغرفة وبسمك مناسب بحيث توضع على الحوائط كاملة . ثم تملأ الفراغات التى بين الالواح بحشوها بكسر الحجارة والجير ثم ترش جميع الحوائط والأسقف من الداخل والخارج بالجير .



نموذج لمنزل مبنى بالحجارة
استخدمت الحجارة الكبيرة للحوائط والشرائح الحجرية للسقف

٣ ــ المنازل المبنية بالطوب

يستخدم الطوب فى تشييد حوائط البناء سواء كانت حاملة load bearing أو غير حاملة ، كذلك يستخدم فى رصف الأرضيات وعمل العتبات للأبواب والشبابيك .. الخ .

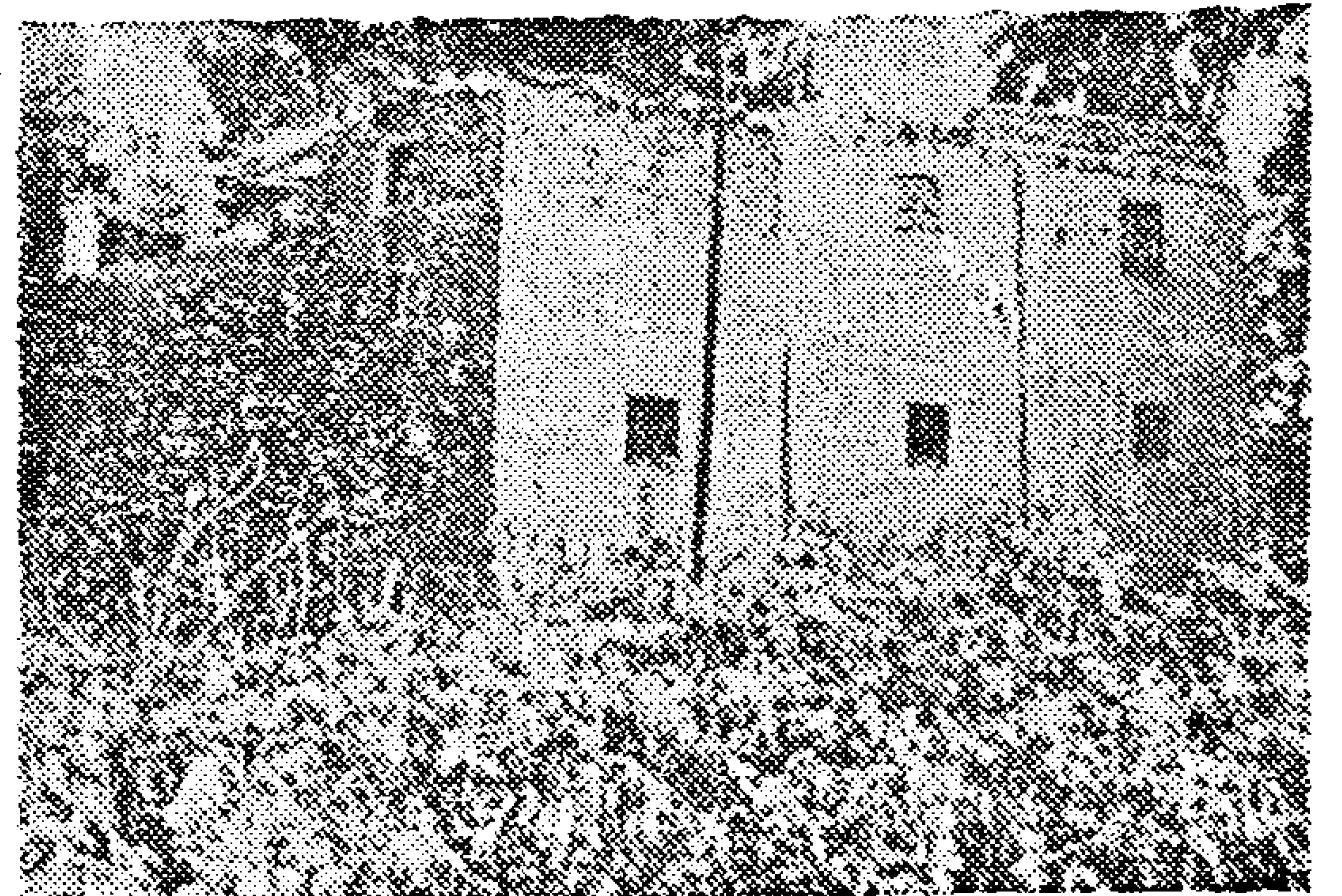
ويفضل للحوائط الحاملة باستخدام لا يقل عن طوبة واحدة لسمك الحائط للمنازل ذات الطابقين ــ كما يستخدم الطوب المدعم بأسياخ

الحديد للأسقف وتتبدل هذه الأسقف بعد ٢٠ ـ ٢٥ سنة لأن الحديد المدعم للطوب يصيبه الصدأ نتيجة للرطوبة .

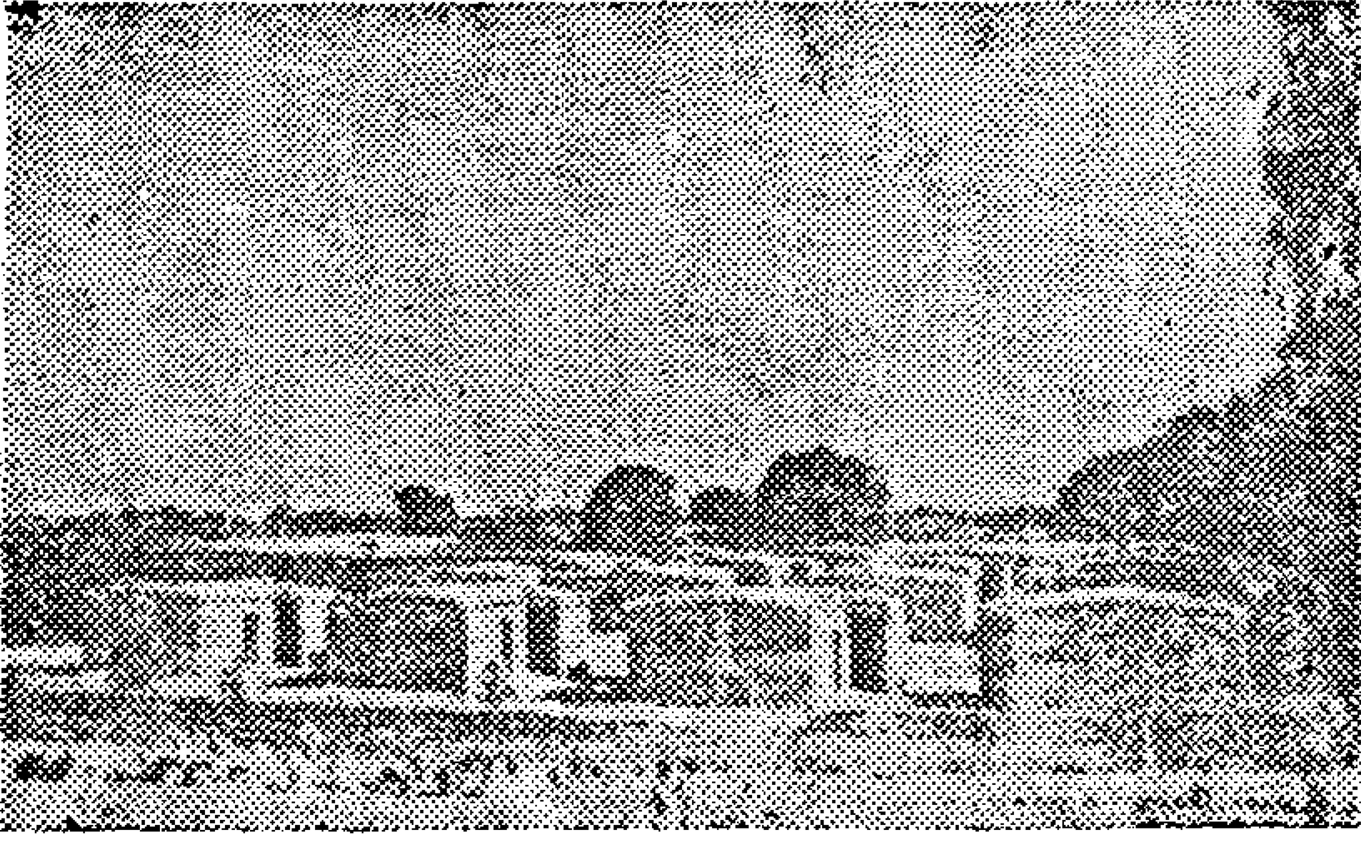


نموذج آخر لمنزل مبنى بالحجارة

وللتغلب على هذه المشكلة ولزيادة كفاءة البناء يمكن استخدام طريقة محسنة لبناء الأسقف وذلك باعداد قوالب أولية (اسطمبا) على شكل سطح من الطوب المدعم بالأسياخ الحديدية محاط باطار على الأرض بعرض متر واحد . ثم يوضع هذا السطح المصبوب على القوالب الأولية للعوارض الخرسانية المدعمة لعمل السقف . ويرش السقف بعد ذلك بالخرسانة الأسمنتية لمعالجته ضد المؤثرات الجوية ـ كما يمكن تشكيل الأسطح مستوية (أفقية) أو منحدرة (مائلة) .



نموذج لمنزل مبنى بالطوب (حوائط حاملة)



نموذج لمنزل مبنى بالطول المدعم بالاسياخ الحديدية مع استعمال القوالب الاولية المصبوبة بالسقف

٤ ـ منازل البامبو

يعتبر البامبو من المواد المفيدة جدا فى بناء المنازل خاصة فى المناطق ذات المناخ الحار حيث يستخدم فى بناء الحوائط والأسقف للمنازل ـ ولكنه يبدأ فى التصدع سريعا نتيجة الأمطار والتلفيات الناتجة من تآكل البامبو من الحشرات فعمره الافتراضى ما بين ٢ ـ ٣ سنوات .

ولزيادة العمر الافتراضى للبامبو تتم معالجته كيميائيا قبل استخدامه فى البناء . ويتكون المحلول الكيمائى من النحاس والكروم والزرنيخ ـ أو من النحاس والكروم وحامض الخليك . وتتم معالجته كيميائيا أما بوضعه فى المحاليل أو بدهان البامبو نفسه بها .

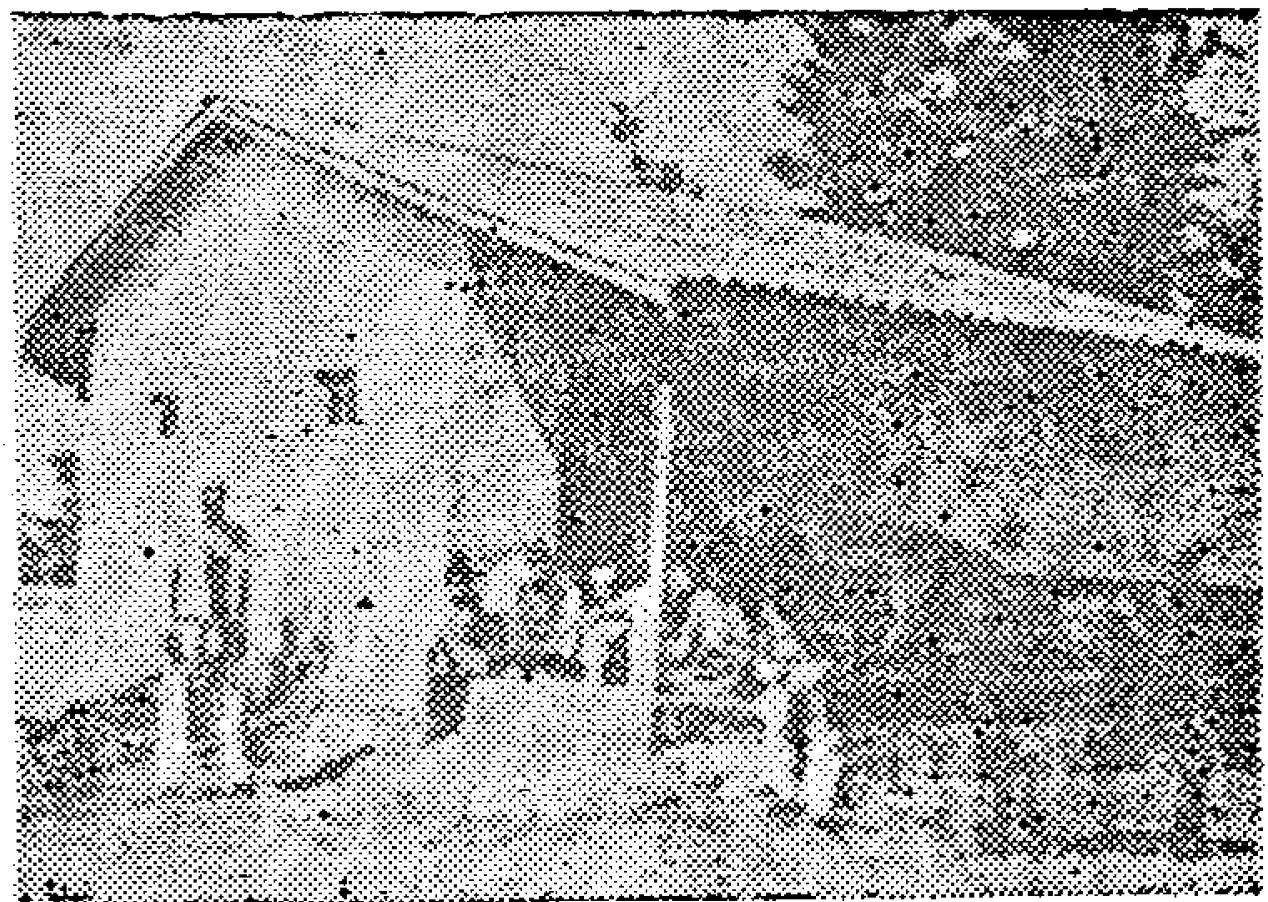
ولعمل الحوائط يستخدم البامبو المجوف أو البامبو المشقوق الى نصفين سواء كان أفقيا او راسيا ـ والبامبو المستخدم فى الحوائط راسيا يكون اكثر تحملا وقوة عن المستخدم افقيا . وتوضع أعواد البامبو داخل اطار مجهز من الخشب القوى والأكثر تحملا عن البامبو .

ولعمل الأسقف يجب استخدام نوعية ذات كفاءة عالية من البامبو ثم تربط جميع اجزاء البناء سويا باتقان بالأسلاك والحبال ثم يغطى سقف البيت الذى حوائطه من البامبو بالقش او جريد النخيل والبامبو المشقوق والطين وصفائح الاسبستوس والصفائح المعدنية المختلفة .

٥ ـ المنازل الخشبية

تستخدم الألواح والعوارض والكمرات الخشبية فى بناء المنازل بالمناطق التى تتوفر فيها الأخشاب بمعدلات رخيصة .

فتستخدم الاعمدة الخشبية لعمل الهيكل الخارجى للمنزل بينما تستخدم الألواح الخشبية لعمل الأسقف والأرضيات وبناء الحواجز بين الغرف .

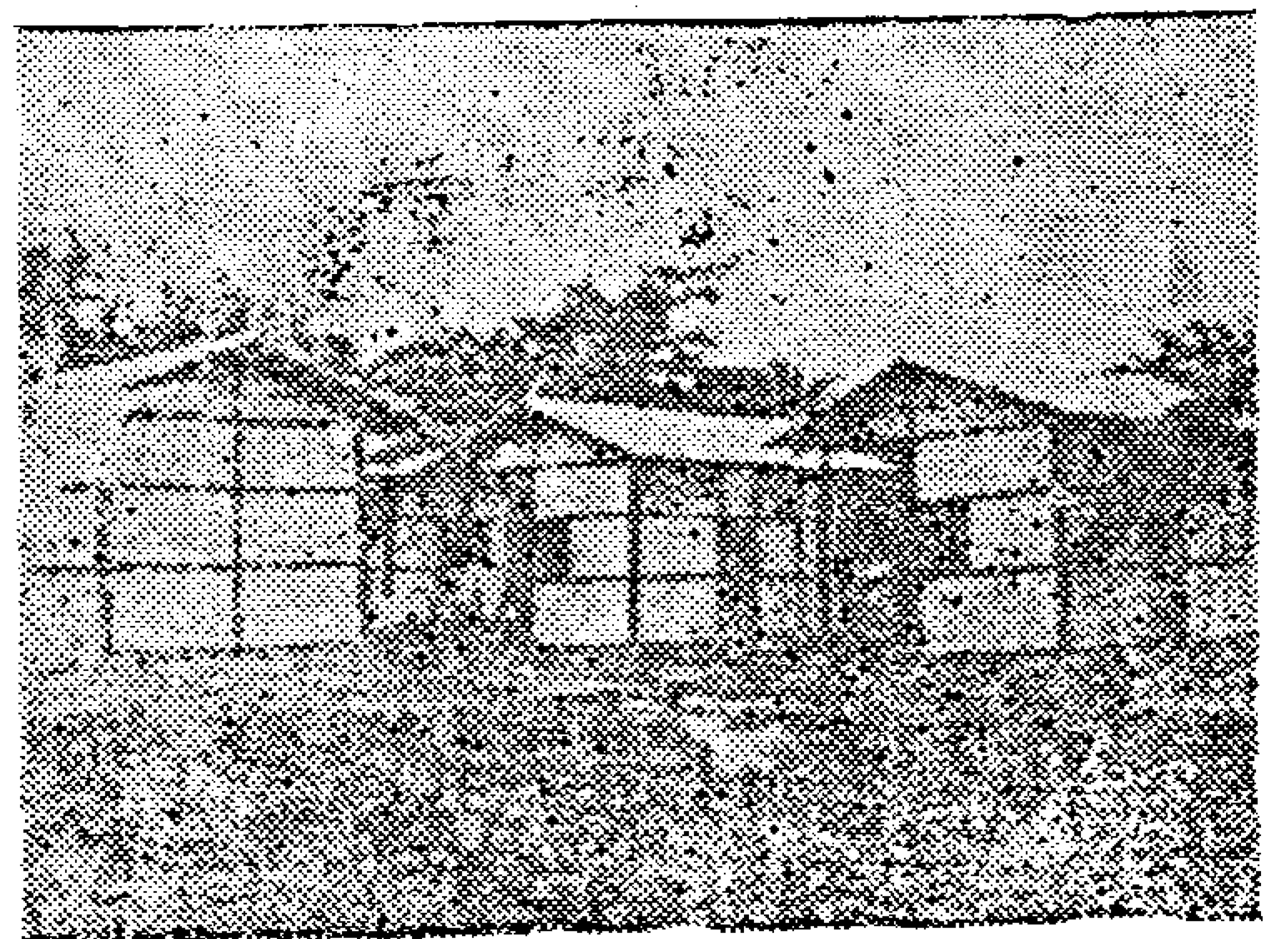


نموذج لمنزل مبنى بالبامبو مع دهان الحوائط والاسقف الداخلية بالطين واستخدام الاسبستوس بالسقف الخارجى

ويمكن استخدام فلقات البامبو أو الاحجار او طوب البناء فى بناء الحوائط . اما الكمرات والعوارض الخشبية فدائما ما تستغل فى بناء الأسقف المستوية — اما فى بناء الأسقف المنحدرة فتشد العوارض على شكل مثلثات ويملأ مابينهما بالواح خشبية بمسافات معينة تملأ بالقش والطين . ثم تغطى الأسقف بمزيد من الواح الاسبستوس الأسمنتية أو الألواح المعدنية المجلفنة لتجعلها اكثر تحملا وقوة .

ويفضل استخدام طبقات من الأسفلت على الأسقف فى المناطق الباردة والتى لا تقل درجة الحرارة فيها عن ٣٧° فى الظل .

ومع زيادة أسعار الأخشاب نتيجة الاقبال الشديد عليها فى كل بلاد العالم ولنقص انتاجها — فانه أصبح من الضرورى استخدام اخشاب الفرز الثانى المتوفرة محليا فى المناطق المنتجة للأخشاب بعد معالجتها ومعاملتها بطرق معينة لتقويتها وأصبحت بذلك المستخدمة فى الأسقف والأبواب والشبابيك .



نماذج من منازل خشبية توضح العوارض والكمرات الخشبية المستخدمة فى التشييد

نتائج استخدام التكنولوجيا فى تشييد المساكن

لتعزيز فكرة استخدام التكنولوجيا لاستغلال المواد الخام قليلة التكلفة للاسكان الاقتصادى فى الدول النامية يجب مراعاة :

١ — استغلال الطاقات الكامنة الرخيصة والمحلية استغلالا كاملا فى الدول النامية لتوفير الطاقة المستهلكة المطلوبة لانتاج مواد البناء مثل الأسمنت والحديد وباستخدام التكنولوجيا يزداد تحسن انتاجية المواد الخام لتؤتى بنتائج ناجحة من استغلال هذه الطاقات .

٢ — المحافظة على الطاقة المستهلكة عند انتاج المواد الخام المحلية مثل الطوب اللبن والكتل الأسمنتية — ولاستخدام التكنولوجيا فى انتاج الجير والطين تأثير كبير نتيجة تصميم القمائن بأساليب فنية وعلمية .

٣ — وللحصول على نتائج استخدام التكنولوجيا فى المبانى يجب اعادة النظر فى مستوى المبانى ، نوعيتها ، طريقة بنائها واعادة تصميم وطرق الانشاء لتصبح اكثر فائدة من حيث المحافظة على الطاقة .

٤ — وتساهم استخدام التكنولوجيا فى الاستفادة من مخلفات الصناعة والزراعة لانتاج مواد البناء المختلفة .

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طرق التحكم الشمسى للنوافذ

أ.د. محمد صلاح الدين السيد *

مقــــدمة :

تعتبر النوافذ درة جمالية من عناصر الجمال المعمارى وهى رئة المبانى التى يتنفس من خلالها السكان وهى وسيلة الاتصال البصرى للانسان بالمحيط الخارجى وهى مدخل الاضاءة الطبيعية والطاقة التى يمكن بالتحكم فى استخدامها جلب الراحة الحرارية والبصرية والسرور للانسان لذلك يجب على المهندس المعمـــارى مراعاة اســـتخدام الطرق المختلفــة للتحكم الشــمسى لفتحات عند المراحل الأولى من تصميم المساقط الافقية والقطاع والواجهات المختلفة التوجيــه للمبانى بغرض تأديتها لوظائفها بكفاءة علاوة على ترشيد الاشعة الشمسية الساقطة والمنعكســة لتعليل الحرارة المكتسبة الزائدة داخل الفراغات فى الفترات الأعلى من المحتملة حراريا مع السماح بدخول الأشعة لزيادة الحمل الحرارى داخـل الفراغات فى الفترات المطلوبة .

ويجب على المصممين والمهندسين التعرف على أهمية المواد المختلفة للنوافذ وتأثيرها على توفير الطاقة مع الأخذ فى الاعتبـار الدور الجمـالى والوظيفى وســـلوك مـواد النوافذ وكيفيــة استخدامها فى المبانى .

١ ــ الأهداف التصميمية للنوافذ :

يهدف المهندس المعمارى عند تصميم النوافذ ان تفى بالوظائف التالية :

١ ــ ترضى حاجة الانسان للاتصال البصرى على العالم الخارجى وتعطى المعلومات الأولية عن الطقس .

٢ ــ السماح بدخول اشــعة الشمس لتعطى الضوء والحرارة وفى بعض الأحيان تسمح بدخول الهواء الخارجى المستحب .

٣ ــ تستخدم للهروب من الحريق والطوارىء فى المبانى المنخفضة الارتفاع .

٤ ــ تفخم المظهر الخارجى والداخلى للمبانى .

ويجب مراعاة النقاط التاليــة عند تصــميم النوافذ :

١ ــ معماريا وجماليا ــ بواســـطة تحقيق الاختبارات التصــميمية والجمالية للمبنى مـــع تلبية احتياج شاغلى الفراغ للاضــاءة الطبيعية المنتظمة .

٢ ــ حراريا ــ بواسطة تصميم الحرارة المفقودة والمكتسبة ودرجة حرارة السطح الملائمة مع راحة شاغلى الفراغ وترشيد الطاقة .

٣ ــ اقتصــاديا ــ بمقارنة التكاليف الأولية وتكاليف دورة حيــاة العناصر المختلفة لمكونات النوافذ .

٢ ــ متطلبات مكونات النوافذ :

يعتمد تصميم واختيار مواد وعناصر مكونات النوافذ شاملة نوع الزجاج وأســاليب الظلال الخارجية والداخليــة المناســـبة على التوجيه بالنسبة للشمس وقوة الاضاءة الطبيعية المطلوبة وعلى الخصوصية ومســتوى أهمية الاتصـال البصرى مع الخارج وعلى العناصر الملائمة لدورة الحياة لكامل المبنى داخل البيئة المحيطة والأغراض التصميمية لبرنامج المشروع .

ويمكن التحكم فى سريان الحرارة من الداخل أو من الخارج خلال النوافذ التى تتم بالاشعاع والتوصيل والحمل عن طريق استخدام الزجاج العازل المفرد أو المتعدد أو الزجاج العاكس والملون وكذلك بواســطة أســاليب التحكم الشمسى الداخلية والخارجية حسب متطلبات التصميم . فمثلا عندما تكون السماء أو الأشعة الشمسية مضيئة جدا ومسببة للزغللة يمكن التحكم فيها باستخدام الزجاج العاكس أو الملون الخفيف . وتستخدم الســتائر المصنوعة من النســيج أو البلاستيك وكذلك الستائر المعدنية لضبط درجة الظلال . ويمكن منع سـقوط الأشــعة الشمسية على النوافذ فى الفتــرات الأعلى من المحتملة حراريا والســماح بدخولها فى الفترات المطلوبة بتصميم وتنفيذ الطريقة المناسبة للتحكم

(*) استاذ منتدب بقسم العمارة بكلية الهندسة ــ جامعة عين شمس .

الشمسى سـواء باسـتخدام اللوفرز الأفقية او الراسية الثابتة أو المتحركة طبقا للمتطلبات التصميمية . ويجب تنفيذ الحلوق والفواصل بطريقة محكمة لتقليل الضوضاء الخارجية وتسلل الهواء ، ويمكن التحكم فى الصوت باستخدام الزجاج الثقيل او المتعدد الألواح للنوافذ ، كما يراعى أن تكون مادة الزجاج قوية بدرجة كافية لمقاومة الكسر نتيجة لحمل الرياح والجهد الحرارى .

٣ ـ الوظيفة والخواص التصميمية لوسـائل التحكم الشمسى :

تستخدم أنواع الزجاج العازل والملون والعاكس واساليب التظليل الداخلية والخارجية من وجهة نظر التحكم الشمسى كوسـائل بغرض توفير الحماية لشاغلى الفراغات المعمارية من العوامل التالية :

ـ الحرارة المكتسبة الزائدة داخل الغرف مع ترشيد الطاقة الشمسية .

ـ الزغللة الناتجة عن الاشعاع الشمسى المباشر والمشتت القوى .

ـ التبيان الزائد للاضاءة بغرض الحصول على الانتظام .

وعلى المهندس المعمارى أن يراعى عند تصميم اختيار مواد ووسائل التحكم الشمسى الخارجية بأن تحقق الخواص التصميمية الآتية :

المقـاومة والثبـات :

جميع وسائل التحكم الشمسى يجب أن تصمم بحيث تقـاوم لفترات طويلة التأثيرات البيئية المحلية (أشعة الشمس ، الرياح ، الأمطـار ، الثلوج ... الخ) .

التحكم فى الضوضـاء :

ضوضاء الطقطقة التى تحدث من وسـائل التحكم الشمسى بسبب الرياح وهطول الامطار يمكن أن تقلل تلك الضوضاء باستخدام أشكال أو قطاعات مناسبة من العناصر المنفصلة للتحكم الشمسى مع اسـتخدام اللدائن عند التثبيتات والتوصيلات .

سـهولة التشـغيل :

يجب أن تكون عملية تشغيل وسائل التحكم الشمسى بسيطة وغير معرقلة ويفضـل أن تتم بواسطة تحكم مركزى أوتوماتيكى مزود بوسائل حساسة للجو .

٤ ـ اختيار مادة الزجاج للنوافذ :

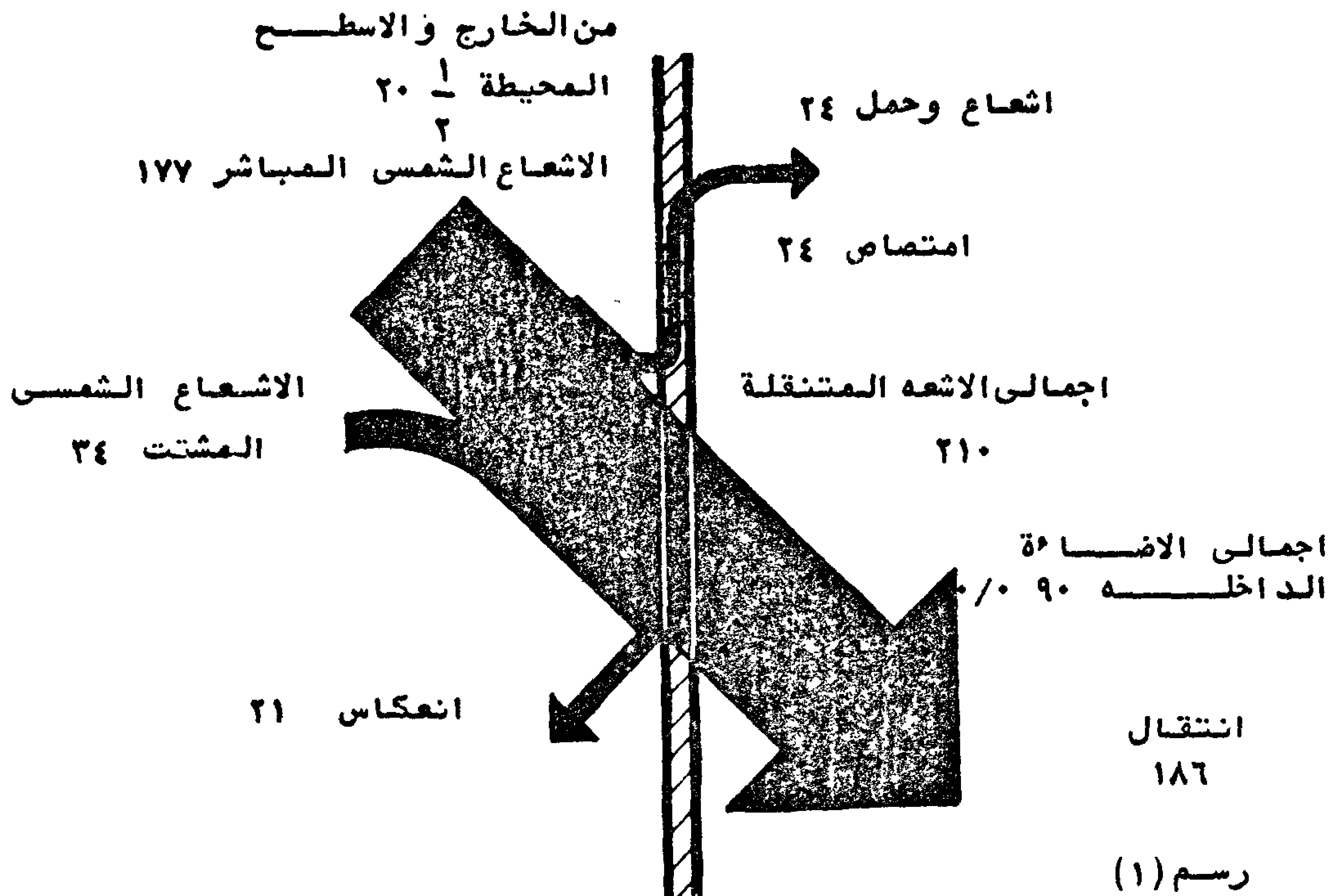
يتوقف اختيار مادة الزجاج على معامل الانتقال الحرارى ومدى الانتفاع بالاضـاءة الطبيعية بالداخل مع التحكم فى الزغللـة بهدف تحقيق الراحة الحرارية والبصرية للانسان علاوة على اختيار سـمك الزجاج المناسب لسـطح النافذة وتنفيذ الفواصل باحكام للحصـول على القوة والمتانة لمقاومة العوامل الجوية وتقليل الضوضاء.

وعندما تكون الاضاءة الطبيعية أساسية من الشمال كما هو مطلوب لصالات الرسم والمكاتب والمعارض والمصانع ، يختار الزجاج من النوع الابيض الشفاف المنتظم . وفى الحالات الخاصة يستخدم الزجاج الملون للشـعور بالخصوصية. وعند استخدام مسـطحات كبيرة من الزجاج للواجهات يختار عامة الزجاج المعزول من النوع الشـفاف والملون والعـاكس لتقليل الانتقـال الحرارى وتخفيف التباين بين الزجاج والمسطحات المحيطة بالفراغ ، ويعطى بيئة خالية نسبيا من الزغللة لمعظم حالات الاضاءة اليومية . من مميزات الزجاج الملون العاكس والزجاج المعزول وخاصة العاكس يقلل الحرارة المكتسبة صيفا والحرارة المفقودة شتاءا علاوة على تقليل الحرارة المتنقلة بالاشعاع بين الانسان ومسطحات الزجاج لذلك تتحقق راحة كبيرة للانسـان على مدار العـام ويمكن أن يقل حمل التبريد من ١٥ الى ٣٠٪ عن الزجاج الأبيض العادى . ويجب معرفة الخواص البصرية للزجاج (درجة شـفافيته ولونه) والحرارية (الانتقال ، الامتصاص ، والانعاكس) من المصـانع المنتجة قبل اسـتخدامه ويمكن بمعرفتها حساب معامل التظليل للزجاج (أنظر رسم ١) عن (مرجع ٦) .

الألواح البلاسـتيكية يمكن انتاجها شـفافة أو نصف شفافة أو مموجة ولهـا قيمـة انتقال حرارى من ١٠ الى ٩٢٪ وقيمة انعاس من ٤ الى ٦٠٪ ولكن يجب الاحتياط عند استخدامها من امكانية التلف بسبب التعرض للعوامل الجوية والخدش .

٥ ـ وسـائل التظليل الداخلية :

يستخدم لمعظم الشـبابيك بعض أنواع من وسائل التظليل الداخلى مثل الستائر المنسـوجة والستائر المعدنية لتحقيق الخصوصية والجمال وتعطى درجات مختلفـة من التحكم الشـمسى وتعتمد كفائة أى وسيلة على أمكانيتها فى عكس واعادة توجيه الأشـعة الشمسية الداخلية الى الشباك مرة اخرى قبل أن تمتص وتتحول الى حرارة داخل المبنى . ووسائل التظليل الداخلية لا تؤثر فقط على مقدار معامل التظليل ولكنها تؤثر أيضا على كثير من العوامل التى تسـاهم فى تكوين البيئة الداخلية للفراغ واعظمها الراحة الحرارية للانسان والعوامل هى :



رسم (١)

انتقال وانعكاس وامتصاص واشعاع للوح من الزجاج الشفاف

٥ ــ ١ الحماية من الطاقة المشعة :

النوافذ الغير مظللة تصبح منابع للحرارة المشعة بسبب انتقال كميات متغيرة من الأشعة الشمسية قصيرة الموجة وانبعاث اشعاع طويل الموجة لتشتيت بعض من الطاقة الشمسية التى يمتصها الزجاج . وتقل عادة درجة حرارة الزجاج فى الشتاء عن درجة حرارة الغرفة بسبب سريان الحرارة للخارج . وربما تؤدى الحرارة المفقوده من الانسان بواسطة الاشعاع بلاتجاه الزجاج البارد الى الشعور بعدم الراحة . كما يشعر الجالسين بقرب النوافذ الغير مظللة أثناء الصيف بعدم الراحة من الأشعة الشمسية المباشرة والاشعاع طويل الموجة المنبعث من الزجاج الساخن من الشمس وتقلل الستائر المنسوجة باحكام والعاكسة نوعا ما من عدم الراحة ولكن الستائر ذات الفتحات تسمح بمرور الموجات القصيرة والطويلة بحرية ، وتعطى وسائل التظليل فاتح اللون لكامل مسطح الشباك حماية جيدة طالما تمتص حرارة أقل وتحاول التخلص بسرعة من الحرارة بواسطة الحمل للهواء مما يحافظ على درجات ملطفة للاسطح .

٥ ــ ٢ الرؤية البصرية الى الخارج :

هى مطلوبة فى كثير من فراغات المعيشة والعمل ويمكن أن تكون غير مرغوب فيها فى حالات أخرى وتسمح الستائر ذات اللون الداكن والفتحات المنتظمة بالرؤيا الخارجية بينما الستائر الفاتحة ذات الفتحات الغير المنتظمة تقلل الرؤيا . والستائر المقفلة تحجز الرؤيا الى الخارج تماما.

٥ ــ ٣ الخصوصية :

تستخدم وسائل التظليل الداخلية لتعطى درجات مختلفة من الخصوصية بالتحكم فى الرؤيا الداخلية من الخارج . الستائر المعدنية سواء أفقية أو رأسية يمكن التحكم فى تشغليها وعندما تقفل كلية تعطى خصوصية كاملة . وعندما تقفل الستائر المنسوجة تتوقف درجة الخصوصية التى توفرها على لونها ومسطح الفتحات بها والاتجاه الذى تدخل منه الاضاءة .

٥ ــ ٤ التحكم فى اللمعان :

عدم الزغللة عنصر مهم فى التشكيل للرؤيا المطلوبة ويجب الا يسمح للشعاع الشمسى المباشر بسقوطه على العين مباشرة كما ان الأشعة الشمسية المنعكسة من الأسطح اللامعة تكون عادة غير محتملة ، وتبلغ الستائر المحكمة « النسيج البيضاء » ذات الانتقال العالى للاشعة الشمسيه تلك الدرجة من اللمعان عندما تضاء بواسطة الأشعة الشمسية المباشرة لانها تسبب زغللة بسبب التباين مع الأسطح المحيطة وفى تلك الحالة يفضل استخدام الألوان البيضاء المقفلة لتخفف من درجة اللمعان . الستائر المعدنية تسمح بدخول اضاءة مقبولة بواسطة الانعكاسات الداخلية بين شرائحها .

٦ ـ وسائل التحكم الشمسى الخارجية :

الطريقة الأكثر تأثيرا لتقليل الحمل الحرارى على النوافذ هى منع الأشعة الشمسية المباشرة قبل أن تصل للزجاج ، النوافذ المظللة بالكامل من الخارج يمكن أن تقلل ٨٠٪ من الحرارة الشمسية ويمكن تظليل النوافذ بواسطة بروز بلاطة السقف أو بروزات معمارية راسية وافقية أو التندات من المنسوجات أو البلاستيك أو اللوفرز الخرسانية ذات المقاسات الكبيرة أو اللوفرز المعدنية صغيرة المقاس . ويراعى التظليل بالنسبة لتغيرات وضع الشمس لتحديد وقت وكمية الاضاءة الشمسية المسموح بدخولها . عند انشاء وسائل التظليل الخارجية تكون حرية حركة الهواء مهمة ليحمل الحرارة الممتصة بواسطة مواد وسائل التحكم والزجاج بعيدا عن المبنى .

٦ ـ ١ البروزات الافقية والراسية :

البروزات الافقيه يمكن ان تقلل من الحراره الشمسيه المكتسبه بواسطه التزويد بالظلال اثناء الفتره الاعلى من المحتمله حراريا ويطبق ذلك خصوصا للواجهات المعرضه للجنوب والجنوب الشرقى والجنوب الغربى وعلى الواجهات الشرقيه والغربيه تكون زاويه سقوط الشمس منخفضه لدرجة ان البروزات الأفقيــة لكى تكون مؤثره يجب أن تكون طويلة جدا وغير عملية ، ويمكن تحديد مقاسات البروزات الأفقية والرأسيه بالطريقة الرياضية عن (ASHRAE 2) كما يلى :

البروز الافقى (P) المتطلب لاعطاء ظلال بارتفاع (SH) على شباك أو حائط لأى وقت من اليوم او السنة يكون متعلقاً بزاوية البروفيل Ω شكل (1) ويمكن استخراج زاوية البروفيل من المعادلة التالية :

$$\tan \Omega = \tan \beta / \cos \gamma$$

حيث β = زاوية السقوط لأشعة الشمس للسطح

و γ = زاوية السموت لأشعة الشمس للسطح

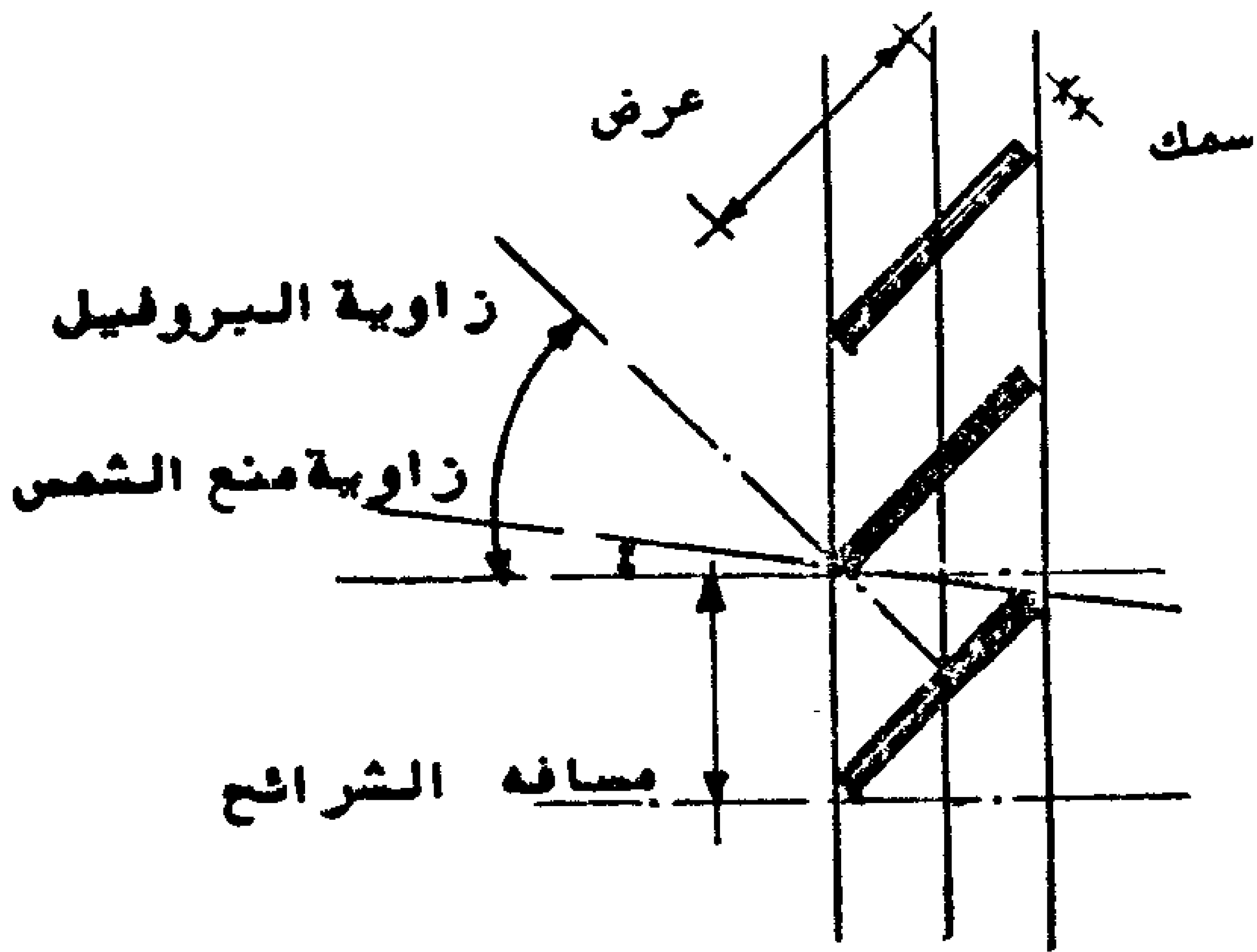
ويستخرج البروز الأفقى (P) من المعادلة التالية :

$$p = SH \cos \Omega$$

والبروز الراسى (PV) المطلوب لاعطاء ظلال بعرض (SW) على النافذة أو الحائط لأى وقت من اليوم أو السنة يتعلق بزاوية السموت الشمسية الراسية (γ) للسطح ويستخرج من المعادلة التالية :

$$pV = SW \cot \gamma$$

ويمكن ايضا تحديد مقاسات البروزات الأفقية والرأسية بمعرفة زوايا الظلال الراسية والأفقية عن طريق استخدام خريطة مسار الشمس لزاوية خط العرض المطلوب ولجميع الواجهات المختلفة.

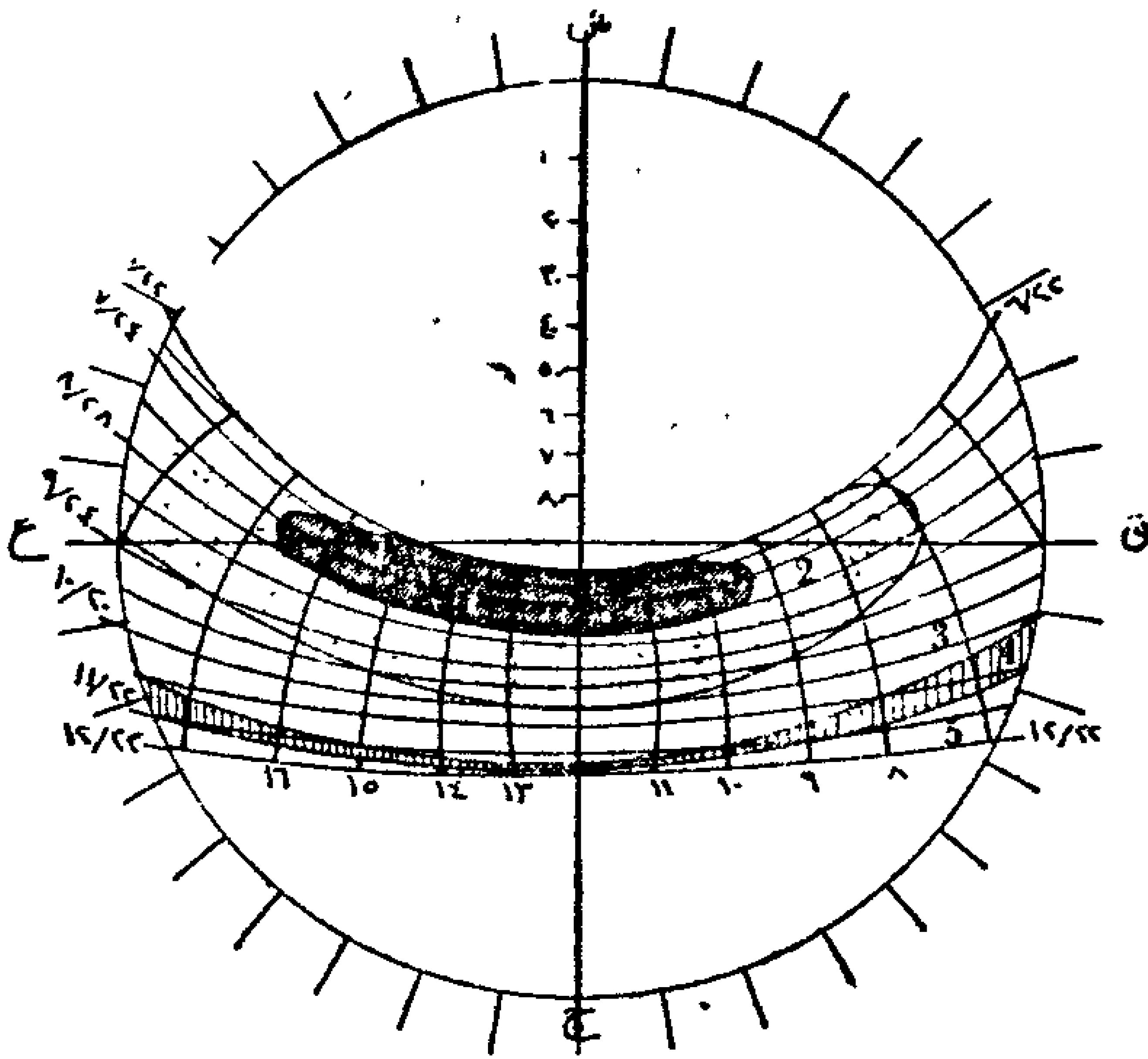


شكل (١) اسكتش قطاع لطريقة التظليل الشمسى بالشرائح .

ويجب اولا تحديد مناطق الراحة الحرارية المختلفة للانسان بالمنطقة المناخية موضوع البحث ، حتى يمكن تحديد فترات المنع وفترات السماح بدخول الأشعة الشمسية .

ولقد حدد الباحث مناطق الراحة الحرارية المختلفة للانسان المصرى (مرجع ١) وتوضح اللوحة (١ أ) ، (١ ب) تلك المناطق الحرارية موقعة على خريطة المسار الشمسى لمدينة القاهرة .

٥٣٠ شمال



المناطق الحرارية المختلفة لمدينة القاهرة المده من ٢٢/٦ حتى ٢٢/١٢

لوحة (١ أ)

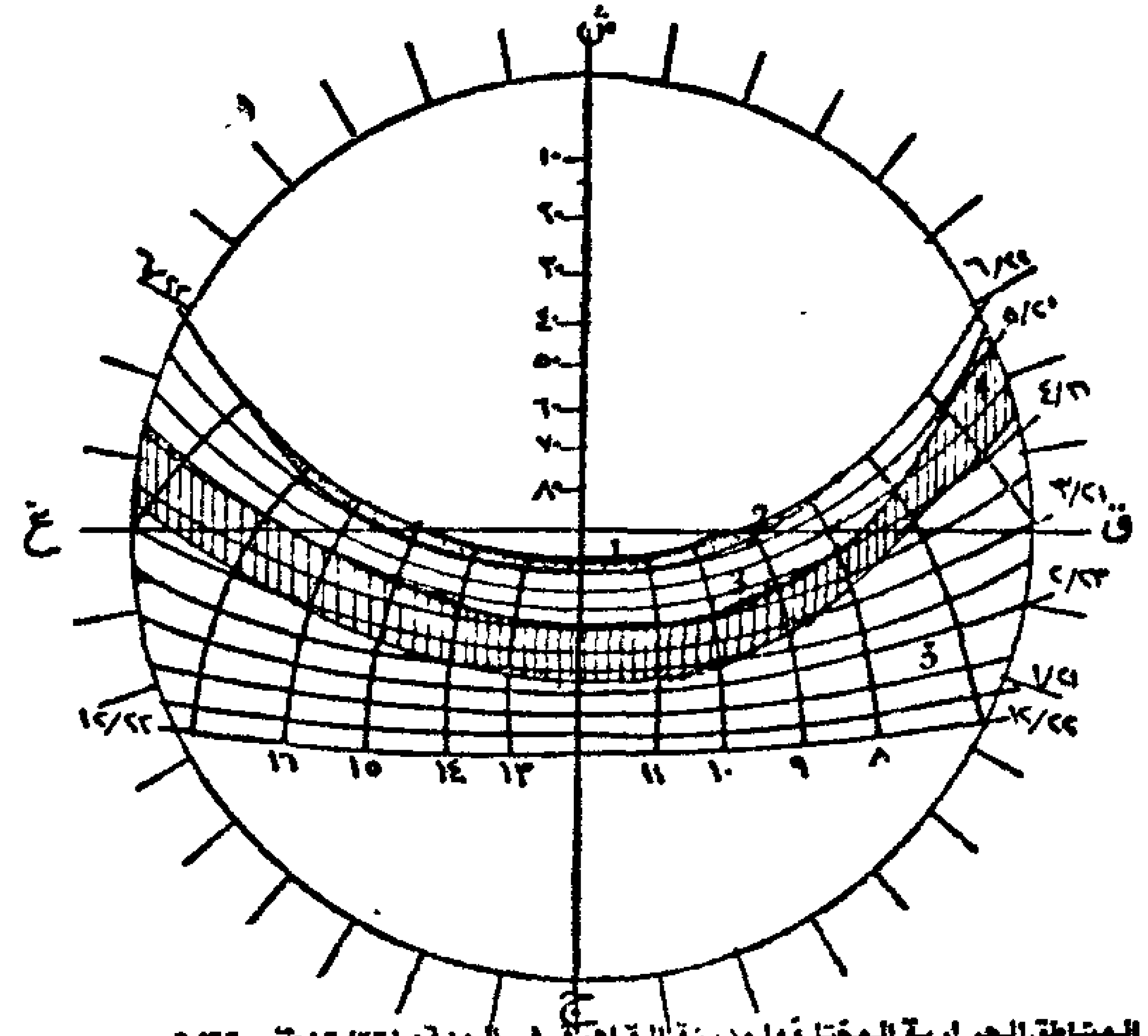
(١) منطقة أعلى من المحتملة حراريا .

(٢) يمكن احتمالها حراريا .

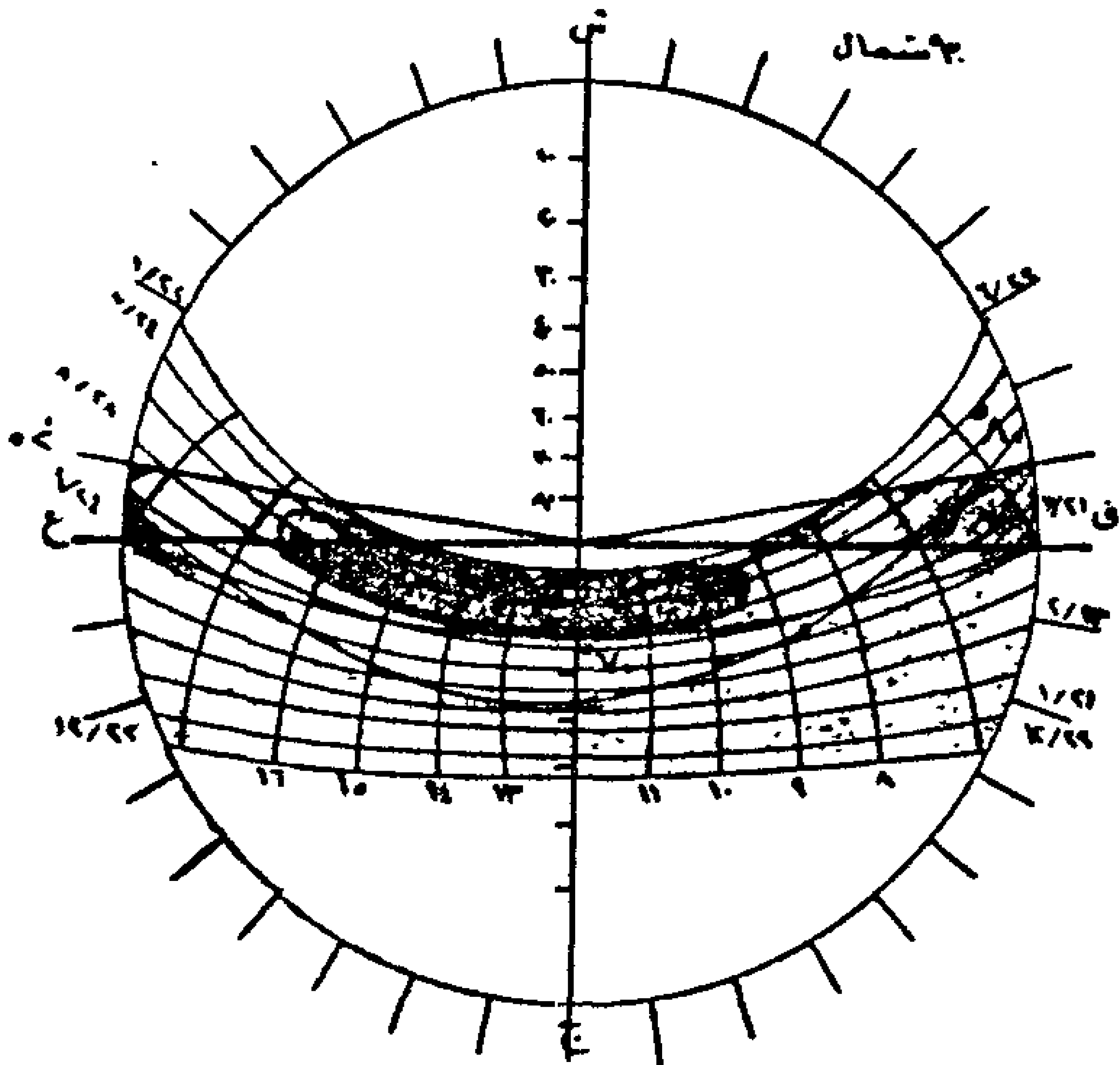
(٣) مجال الراحة الحرارية .

(٤) يمكن احتمالها حراريا .

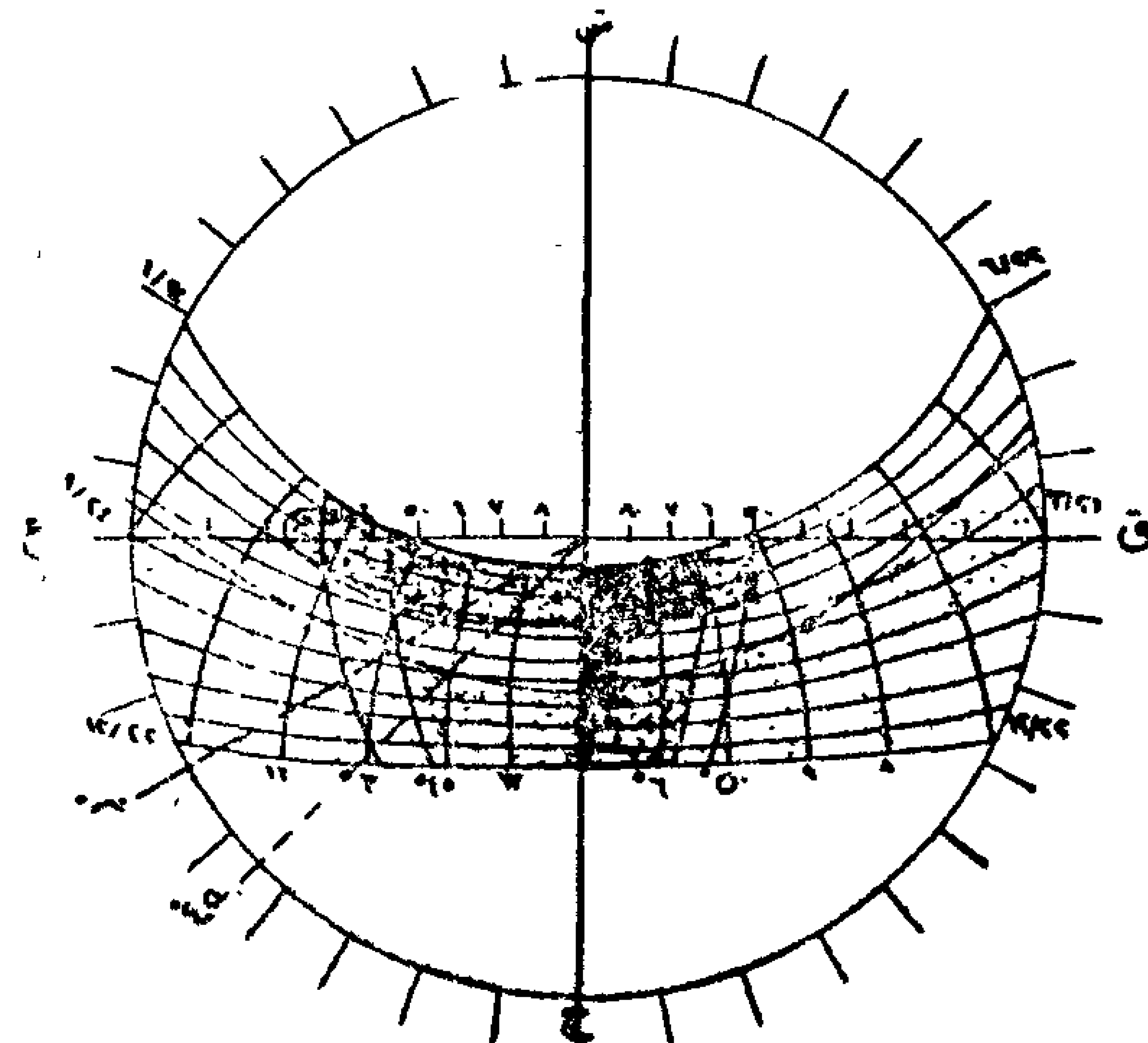
(٥) منطقة أقل من المحتملة حراريا .


المناطق الحرارية المختلفة لمدينة القاهرة في المدة من ٢٢/١٢ حتى ٢٢/٦

لوحة (١ ب)

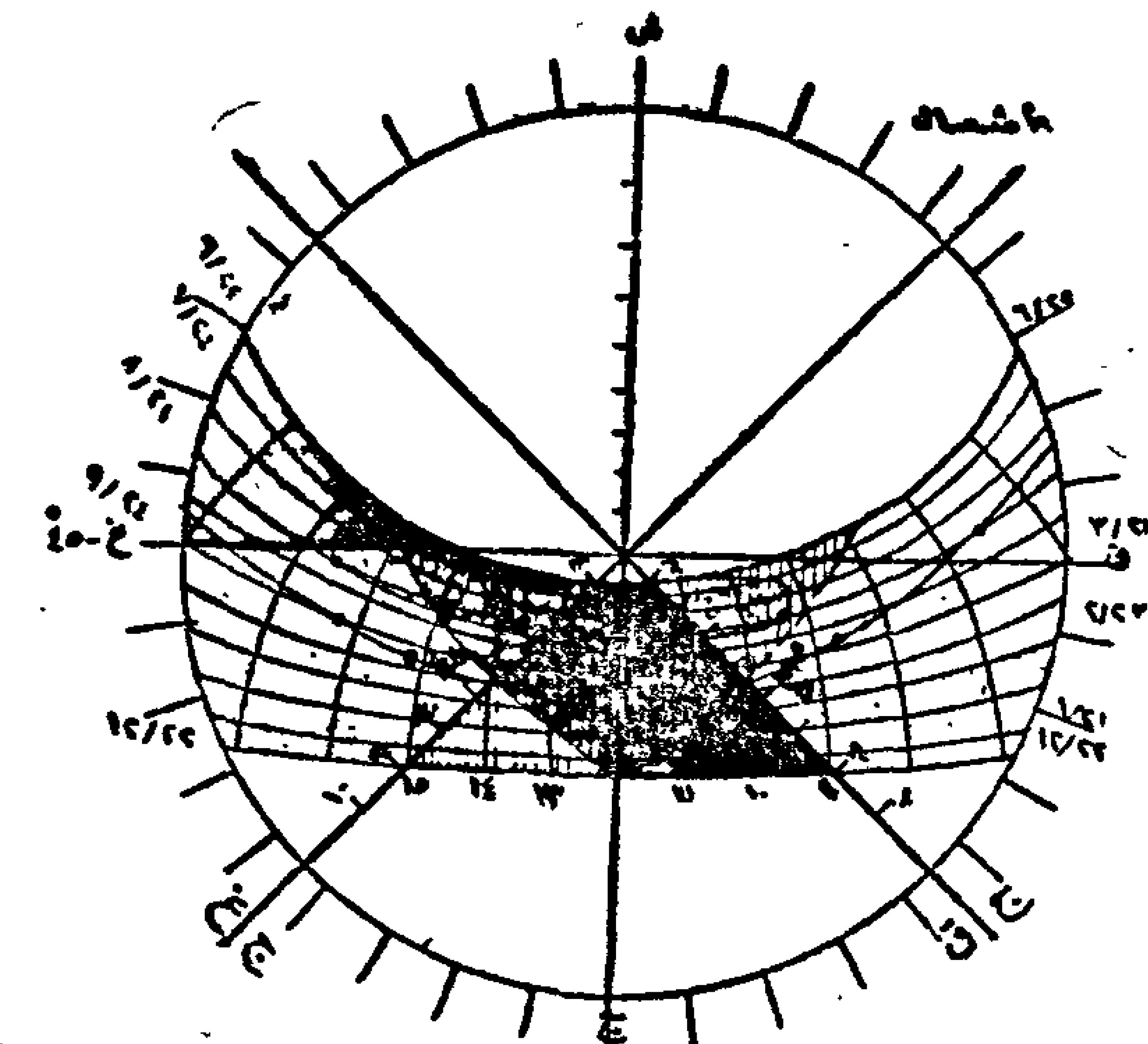

شكل (٢) زوايا الظلال للواجهات الجنوبية والشمالية لمدينة القاهرة

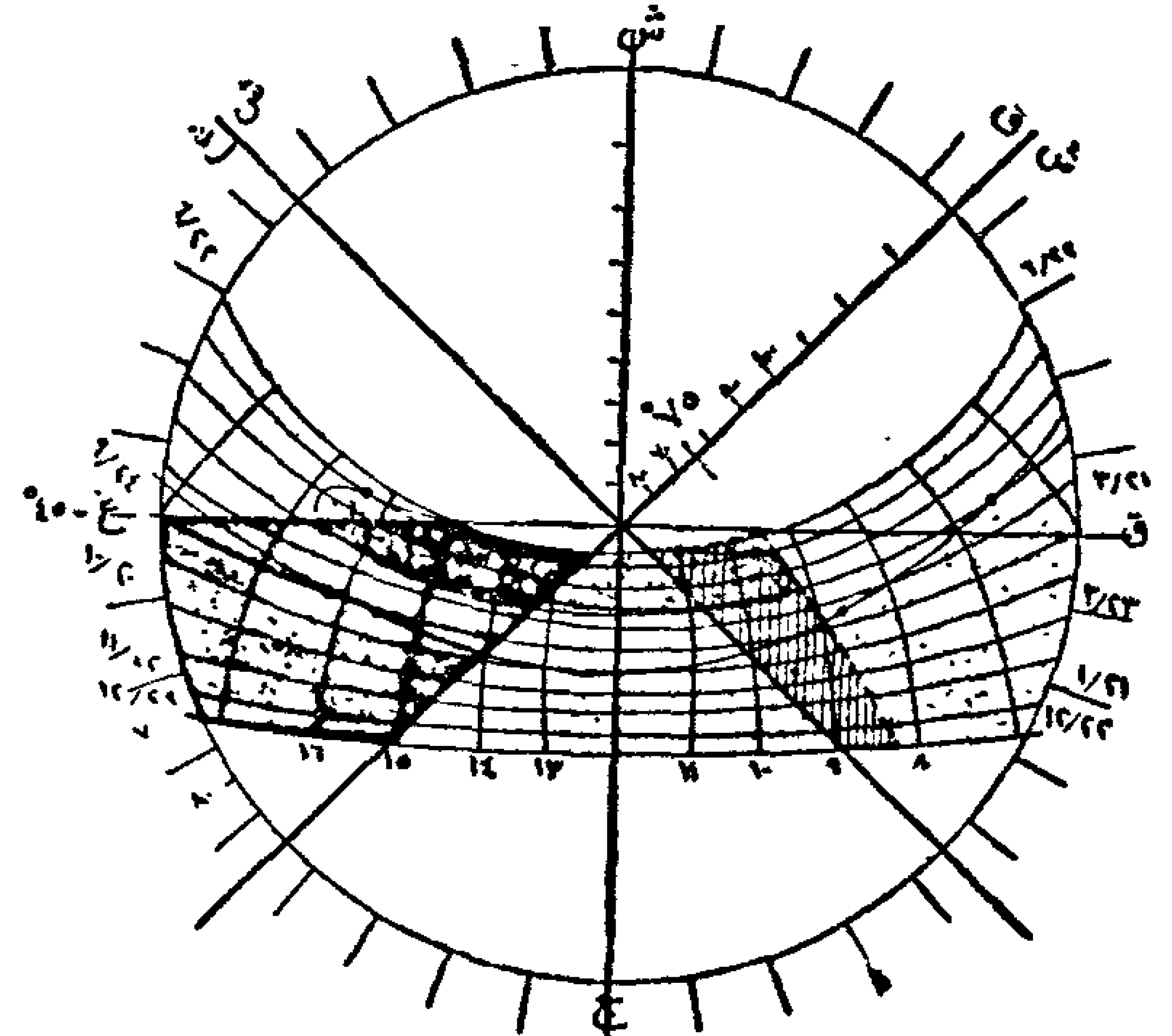
باستخدام اللوحة (١ أ) و (١ ب) لخريطة المسار الشمسي لمدينة القاهرة والموقع عليها مناطق الحرارة الحرارية المختلفة وبواسطة منقلة الظل يمكن تحديد زوايا الظلال المطلوبة للواجهات المختلفة للمباني بمدينة القاهرة ، بحيث نمنع مرور الأشعة الشمسية الى النوافذ والحوائط الخارجية أثناء ومعظم الفترة من العام الأعلى من المحتملة حراريا (رقم ١ على اللوحة) وفي نفس الوقت تسمح بسقوط الأشعة الشمسية على النوافذ والحوائط الخارجية للمباني أثناء معظم الفترة الأقل من المحتملة حراريا (رقم ٥ على اللوحة) . ويوضح شكل (٢ ، ٣ ، ٤ ، ٥) زوايا الظلال المقترحة للواجهات المختلفة بمدينة القاهرة كما هي مبينة بالجدول الآتي :


شكل (٣) زوايا الظلال للواجهات الشرقية والغربية لمدينة القاهرة

الواجهة	زاوية الظل الرأسية	زاوية الظل الأفقية
شمالية		٨٠°
جنوبية	٧٠°	
شرقية	٦٠° ـ ٥٠°	
غربية	٤٥° ـ ٣٠°	
شمالية شرقية	٧٥° ـ ٦٥°	
شمالية غربية		٤٥°
جنوبية شرقية	٥٥° ـ ٤٥°	
جنوبية غربية	٤٥°	٤٥°

جدول (١) زوايا الظلال الرأسية للبروزات الأفقية وزوايا الظلال الأفقية للبروزات الرأسية للواجهات المختلفة للمباني بمدينة القاهرة .

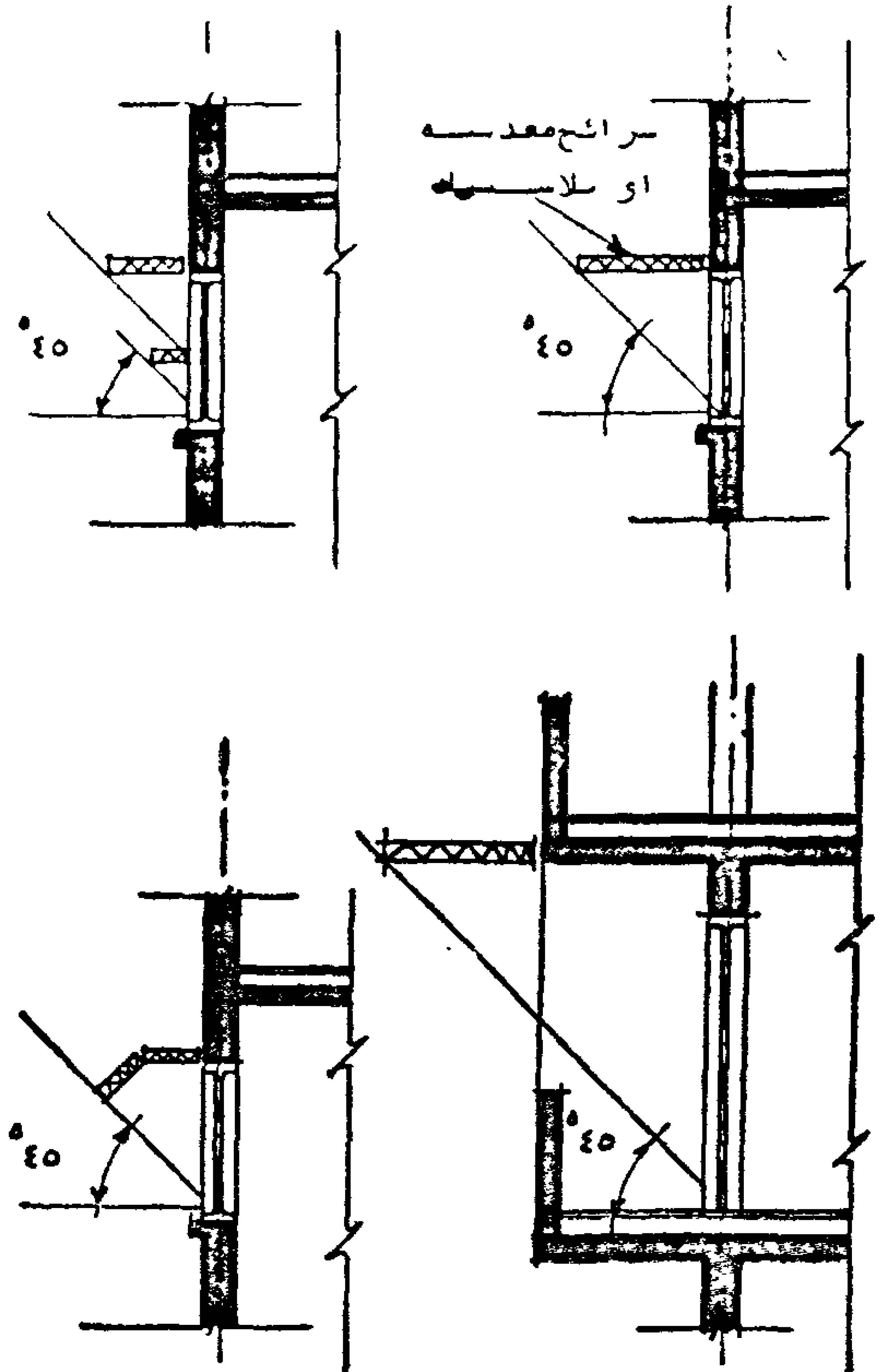

شكل ٤ - زوايا الظلال للواجهات الجنوبية الشرقية والجنوبية الغربية لمدينة القاهرة



شكل (٥) زوايا الظلال للواجهات الشمالية الشرقية والشمالية الغربية لمدينة القاهرة

٦ - ٢ حواجز الشمس الأفقية والرأسية الثابتة:

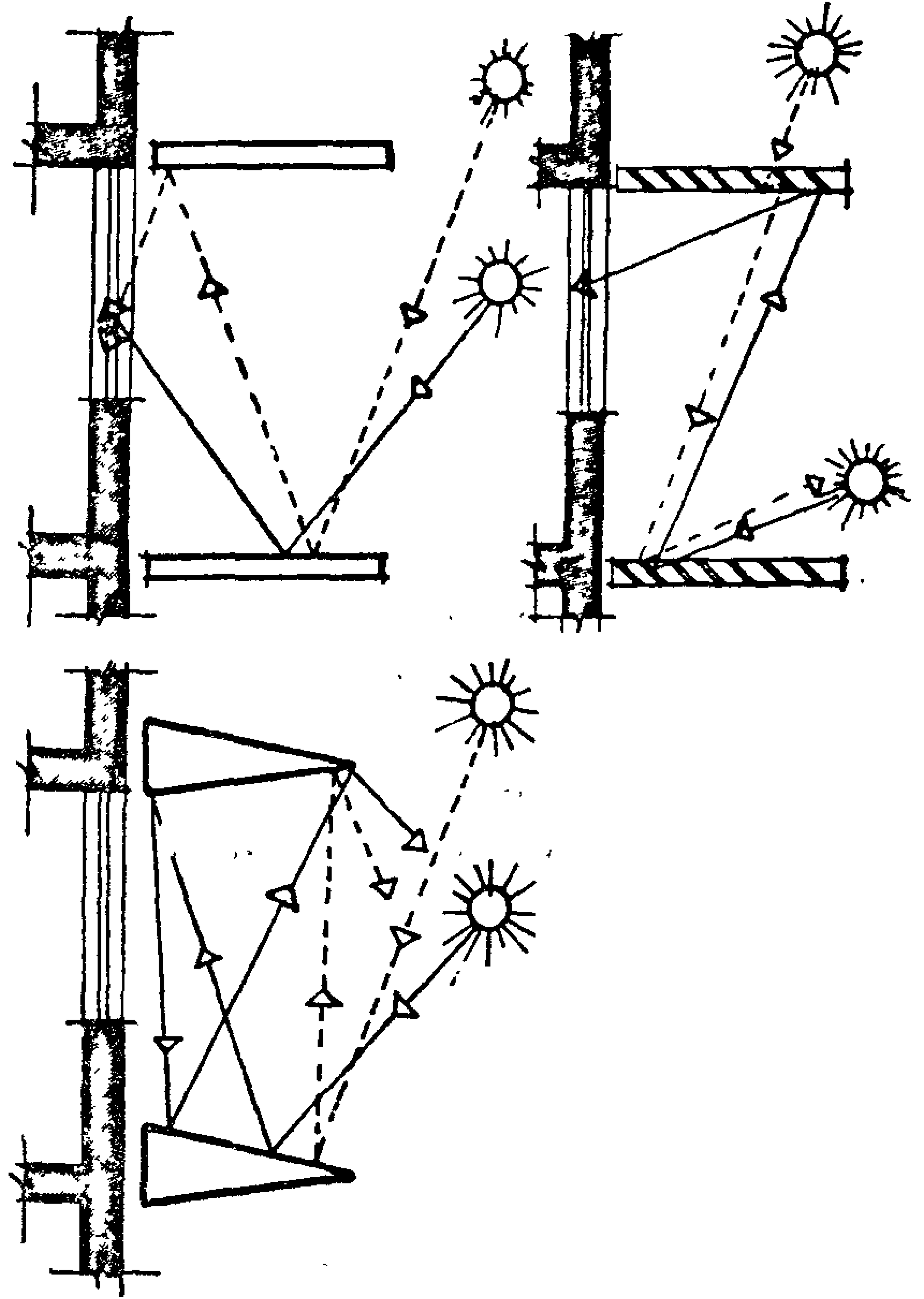
تستخدم حواجز الشمس الأفقية الثابتة بكفاءة للحوائط الخارجية الجنوبية والشرقية والشمالية الشرقية (انظر شكل ٦) فهى تعطى حماية كافية من الأشعة الساقطة فى الفترة الأعلى من المحتملة حراريا وتسمح بدخول الأشعة الشمسية بقية فترات العام وخاصة للواجهات الجنوبية ويمكن استخدام حواجز الشمس الرأسية الثابتة للحماية الجزئية للواجهات الشرقية والغربية من الأشعة ولكنها تمنع دخول جزء من الأشعة الساقطة خصوصا من خلال النوافذ فى الفترات الاقل من منطقة الراحة الحرارية ، علاوة على تقليل الاتصال البصرى مع الخارج .



شكل ٦ - حلول مختلفة لوسائل التحكم الشمسى الأفقية الثابتة للواجهات الجنوبية بزاوية سقوط للاشعة ٧٠° وللشرقية بزاوية سقوط من ٦٠ الى ٥٠° وللجنوبية الشرقية بزاوية سقوط ٤٥° وللشمالية الشرقية بزاوية ٧٥° .

ويمكن أن يتسبب استخدام اللوفرز الخرسانية خاصة للمبانى العالية نتائج عكسية صيفا حيث انها تمتص جزء كبير من الطاقة الساقطة وتختزنها وتحولها الى حرارة ثم تشعها على شكل أشعة تحت الحمراء فى اتجاه الشبابيك وحوائط المبنى مما يحدث تأثير عكسى على المناخ الداخلى للفراغات حتى بعد غروب الشمس . كما ان اللوفرز الأفقية أو الأرفف الضوئية يجب الا تكون ملاسقة للحوائط الخارجية حتى لا تعوق التهوية وكذلك الحركة الرأسية للهواء الساخن عن طريق الحمل . ويمكن تصميم الكاسرات الشمسية من شرائح منفصلة تصنع من مواد رقيقة خفيفة الوزن وضعيفة الامتصاص والتخزين الحرارى وسريعة التوصيل للحرارة لتشعها للهواء الخارجى وتكون الوانها فاتحة لعكس الأشعة ويراعى فى تصميم أشكالها انكسار الأشعة الساقطة والمنعكسة الى خارج المبنى (انظر شكل ٧) .

ويمكن تقسيم الكاسرات الشمسية الأفقية البارزة بروزا كبيرا الى حواجز معلقة أمام النوافذ بحيث تمنع مرور الأشعة بين عناصرها المنفصلة مع مراعاة أن هذه الطريقة تقلل من الاتصال البصرى الخارجى وتضعف الاضاءة الطبيعية ولتخفيف وزنها وتقليل تخزينها للحرارة يمكن تصنيعها من الشرائح المعدنية او البلاستيكية الخفيفة على أن تقل المسافات بين الشرائح القريبة من الواجهة للتأكد من عدم نفاذ الأشعة عندما تكون الشمس عالية وقت الظهيرة وخصوصا فى البلاد الحارة حيث انها تكون شبه عمودية وتعتبر عناصر البناء البارزة مثل الكرانيش والمظلات والابراج والأرفف الضوئية ... الخ وسائل تحكم شمسية ثابتة .

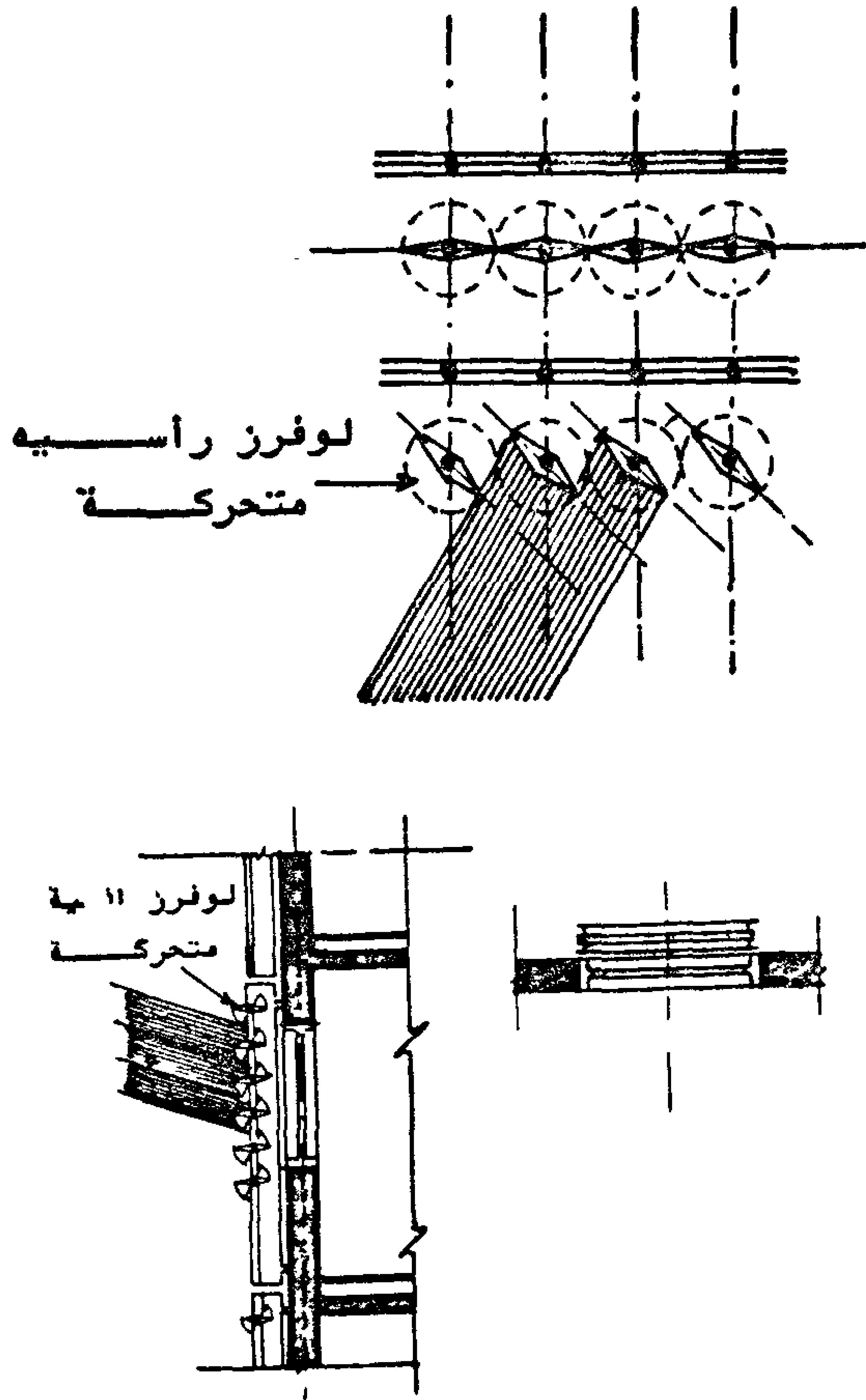


شكل (٧) ـ تشـــكيلات مختلفة لكاسرات الشمس الأفقية .

٦ ـ ٣ حواجز الشمس المتحركة :

الحواجز الراســية والأفقية المتحركة والتى يمكن دورانها حول محـور تثبيتهـا يفضـــل استخدامها خاصة للواجهات الغربية والجنوبية الغربيـة والشـــمالية الغربيـة ويجب تركيب الحواجز الأفقية المتحركة على بعد مسافة قليلة من الواجهة لكى تسمح بمرور الهواء الســاخن المرتفع لأعلى وبحيث الا توجه هـذا الهواء عند دورانها الى داخل المبنى من خلال النوافذ وان تسمح بالتهوية الطبيعيـة للمبنى . وتتميز الحواجز الأفقيـة المتحركة بالتحكم الافضـــل لدخول الأشعة الســاقطة والمشـــتته وتحدد مقاسات الحواجز والمسافات بينها على اساس اقل زاوية لسقوط الأشـعة الشمسية المطلوب حجزها مع مراعاة ان الاتصال البصرى بالخارج وكذلك اضاءة الغرف سوف يتحدد عند استخدام هذه الوسائل للتحكم انظر شكل (٨) .

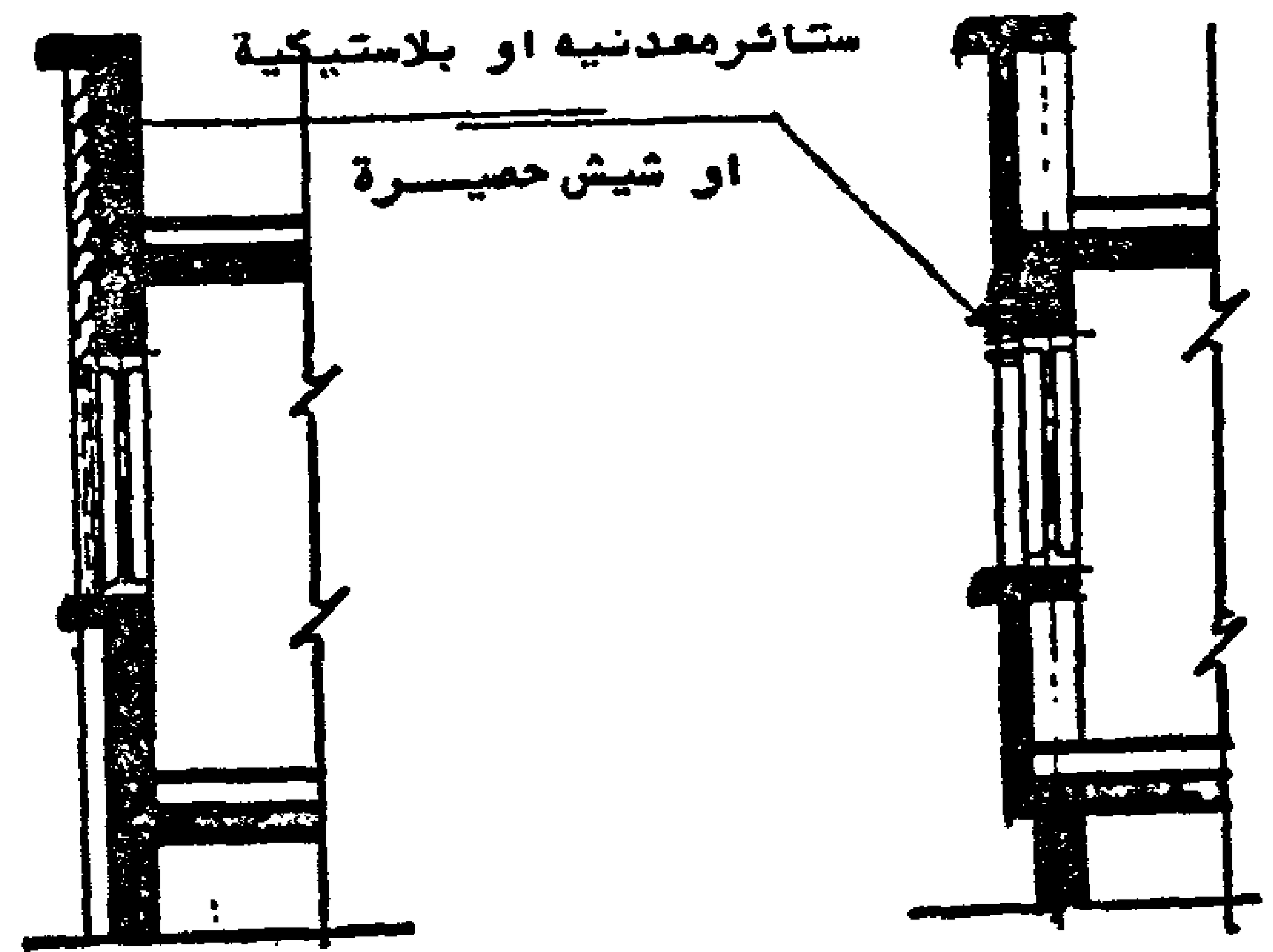
من وجهة نظر الحماية الشمسية والاضـاءة اليومية الطبيعية تقدم الستائر المعدنية المركبة خارج الفتحات للتوجيهات المختلفة معظم الميزات فهى يمكن تطبيقها او قفلها او دورانها معتمدا على اضاءة الفراغات بل يمكنها ان تعطى توزيع جيد للضوء المشتت داخل الفراغات وكنتيجة لوزنها الخفيف وامكانية تحركها تكون الستائر المعدنية الخارجية حساسة للجو وخاصة لمشاكل الرياح .



شـكل (٨) ـ وســـائل التحكم الشمسى الراسية والأفقية المتحركة .

ولذلك يجب ان تصنع الشرائح من مادة قوية بسمك كاف وتثبت جيـدا فى الدليـل الخاص بها لتقاوم العوامل الجوية ويفضل اسـتخدام وسائل التحكم الاتوماتيكية الحساسـة للجـو للمبانى العالية .

كما انه يمكن اســـتخدام طريقة الســـتائر المعدنية الخارجية التى يمكن تخزينها داخل علبة امام جلسة الشبابيك التى تعلو النوافذ المـراد حمايتها فى حالة عـدم الاحتياج اليها (انظـر شكل ٩) ولكن ذلك يجعـل المعمارى مضـطرا لترك مساحات مصمته فوق الفتحات لا يقـل ارتفاعها عن ارتفاع الفتحة . وربما تسـتخدم المظلات باقل فعالية عند استخدامها فى المبانى العالية بسبب تجميـع الهواء السـاخن تحتها وانهيارها المتوقع نتيجة لحمل الرياح العالى .



شكل (٩) ـ وسائل التحكم الشمسى المتحركة للواجهات الغربية والجنوبية الغربية .

الخلاصـــة :

١ ـ يفضل توجيه المباني والفتحات للشمال والجنوب لسهولة الحصـــول على الاســـتخدام الامثل للاضاءة الشمســية مع ترشــيد للطاقة والحمل الحرارى للمبنى كما يجب عمل التدابير والاجراءات اللازمة بالوسائل المعمارية المناسبة عند توجيه المباني باتجاه الشرق والغرب وخاصة الواجهات الغربية فهى تحتاج لاستخدام وسائل الظل الديناميكية للتحكم فى الزغللة والحـرارة الزائدة مع انها تعوق الاتصـــال البصرى مـع الخــارج .

٢ ـ عناصر الظل المعمارية الكبيرة تكون احسن تاثيرا عليها من ناحية التحمل وهى اقتصـادية على مدار الزمن وتعطى اهمية وفخامة للتشكيل المعمارى الخارجي للمباني ويراعى ان تؤخـذ فى الاعتبار عند المراحل الاولى للتصميم وتشكيل المبـانى .

٣ ـ الارفف الضوئية ذات الســطح العلوى العاكس تكون مع الاسقف العالية احسن وسائل الظل واعادة توجيه الاضاءة الشمسية .

والارفف الضوئية كعناصر معمارية كبيرة لها اهميتها كغطاء لتشكيل الواجهات بغرض الاضاءة الجانبية وتستخدم بكثرة وتظهر امكانية مـدى التعبير التصميمى ، وهى تتكامل مع المكونات المعمارية الأخرى للواجهـات وتوفى باحتيـاجات شاغلى المبانى وتخلق فراغات وسـيعة مضـاءة شمسيا تبعث على الراحة والسرور ولكنها تحتاج الى اضافات للتحكم الشاسى للفتحات بالواجهات الشرقية والغربية .

٤ ـ وسائل الظل الديناميكية الخارجية هى انسب وسائل التحكم للواجهات الغربية ويمكن استخدامها للواجهات الشرقيـة وتراعى عنـد تصميمها أو اختيار انواعها ان تكون مضمونة فى تشغيلها وصيانتها والا تضبط وتترك مثبتة أو تستخدم وسائل الظل الديناميكية الداخلية مثل الستائر المعدنية مع انها اقل كفاءة لمنع الحرارة المكتسبة الزائدة التى تنتقـل الى الغـرف عن طريق زجاج النوافذ وبفضل استخدام وسـائل التحكم الكبيرة الثابتـة كعناصر معمارية كبيرة ومتكاملة مع وسائل متحركة صغيرة فى اضيق نطاق وفى حالة الضرورة .

المراجـــع العلمية :

١ ـ المعايير التخطيطية والمعمارية لمراعاة المناخ بالمناطق الحارة الجافة د . صلاح السيد المجلة المعمارية العددين ٧ ، ٨ ـ ١٩٨٧ .

2. ASHRAE Handbook and Produet Directory Fundamentals, New York, 1985.

3. Lippsmeir, George, Tropenbau, München, 1969.

4. Ramsey Sleeper, AIA, Architectural Graphic standard, New York, 1981.

5. Schild Carselmann, Environmental physics in Construction, London,1981

6. William M. C. Lam, Sunlighting, New York, 1986.

تعريف بالوحدات الجيولوجية التى تحمل المياه الجوفية فى أنحاء مصر

د. عبده على شطا *

مقدمة عامة :

منذ مطلع الثمانينات يقوم معهد المياه الجوفية الذى يتبع مركز البحوث المائية فى مصر (وزارة الاشغال العامة والموارد المائية) باعطاء اهمية متزايدة لاعداد الخرائط الهيدروجيولوجية ، وهى تمثل تلك الانواع من الخرائط التى تعنى بتحديد الوحدات الجيولوجية التى تحمل المياه الجوفية ، فضلا عن توضيح الخصائص الهيدرولوجية والخصائص الهيدروكيميائية لها. وفى اطار التعاون بين هذا المعهد وبين عدد من الهيئات الدولية وعدد آخر من المؤسسات الحكومية فى الخارج مثل مجموعة اواكو الهولندية ، وايضا فى اطار تعاون المعهد مع عدد من الهيئات العلمية فى الداخل مثل الجامعات ومعهد الصحراء وهيئة المساحة الجيولوجية وغيرها ، تحقق لهذا المعهد القيام بوضع خطة طموحة لتجهيز الخرائط الهيدروجيولوجية التفصيلية لمساحات واسعة من الوجه البحرى والوجه القبلى ومن منطقة بحيرة السد العالى ، هذا فضلا عن الخرائط الاقليمية لأجزاء متكاملة من الصحراء الشرقية .

وفى أوائل عام ١٩٨٧ قام معهد المياه الجوفية باصدار باكورة انتاجه من الخرائط الهيدروجيولوجية التفصيلية بمقياس رسم ١ : ١٠٠ الف وتغطى المنطقة بين الزقازيق والاسماعيلية فى شرق دلتا نهر النيل . وقد تم توزيع تلك الخريطة على عدد من الجهات المتخصصة فى الوزارات والجامعات والهيئات ومراكز البحث العلمى ، ثم تمت دعوة ممثلين عن تلك الجهات لحوار مفتوح مع الجهاز الفنى بالمعهد وكان هناك تقارب ملحوظ فى وجهات النظر كما كانت هناك بعض الملاحظات التى سوف تؤخذ فى الاعتبار عند اعداد المزيد من تلك الخرائط .

هذا بالنسبة لجهود اعداد الخرائط الهيدروجيولوجية فى مصر ، وبالنسبة لعالمنا العربى ، لقد تبلورت الفكرة لاعداد الخرائط الهيدروجيولوجيه الاقليميه فى اجتماعات كاست عرب Cast Arab الاول الذى عقد فى مدينة الرباط بالمغرب فى غضون عام ١٩٧٦ (اجتماع الوزراء العرب المسئولون عن تطبيق العلم والتكنولوجيا) ، فى هذا الاجتماع اتفق على ان يقوم المركز العربى لدراسات المناطق الجافة والاراضى الفاحله التابع لجامعة الدول العربية (اكساد) باعداد خريطة الموارد المائية للعالم العربى بمقياس رسم ١ : واحد مليون Water Resources Map . وما تزال تلك الخريطة الاقليمية تحت الاعداد ومن المنتظر ان يتم نشرها فى وقت لاحق .

بالتوازى مع عملية اعداد خريطة الموارد المائيه للعالم العربى قام اكساد بالتعاون مع منظمة اليونسكو ومنظمة الاليكسو (جامعه الدول العربية) باعداد خريطه هيدروجيولوجية اقليميه بمقياس رسم ١ : ٥ مليون . وقد تشرفت مع مجموعه من الخبراء فى علوم الموارد المائية بوضع برامج التخطيط والمتابعه. وسوف يتم عرض الطبعة الاولى لتلك الخريطة فى الاجتماع المقرر عقده فى تونس فى خريف هذا العام . فى اطار مقياس الرسم المقرر لتلك الخريطة الاقليمية للعالم العربى (١ : ٥ مليون) سوف تظهر سبعة وحدات هيدروجيولوجية رئيسية ، ومن تلك الوحدات سوف يرى القارىء خمسة وحدات فقط على الخريطة التى تغطى مصر .

من المؤكد انه كانت هناك جهود سابقة تتصل باعداد الخرائط الهيدروجيولوجية فى مصر ، يدل على ذلك ما نجده متناثرا فى محتوى البحوث والدراسات الجيولوجية التى أجريت فى مصر منذ مطلع القرن الحالى، ففى الفترة منذ مطلع هذا القرن وحتى نهاية الاربعينات نجد فى الدراسات التى أجراها الرواد الاوائل اشارات متواضعة حول امكانات المياه الجوفية

* استاذ الهيدروجيولوجيا المتفرغ — معهد الصحراء المطرية — القاهرة — ج‌م‌ع .

فى عدد من التكوينات الجيولوجية . من هـؤلاء نذكر من المصريين المغفـور لهم حسن صـادق ومحمد محمود ابراهيم ومحمود ابراهيم عطية . ولقد تم تحسين المعرفة بتواجد المياه الجوفية فى تلك التـكوينات وفى غـيرها من التـكوينات الجيولوجية فى خلال كل من فترة الخمسينات وذلك عنـد تزايد النشـاط البترولى فى مصر وكذلك عند الاهتمام بخزانات المياه الجوفية فى حـوض نهـر النيـل والدلتـا ، ثم فى فترتى الستينات والسبعينات وذلك فى اطار المشروعات الطموحة لتعمير الصحارى . ومن الرواد الذين برزت اسماؤهم خـلال تلك الفترات المتعاقبة نذكر المرحوم عبد السلام هاشم ومحمود سيد أمين وأحمد فؤاد جانوب وحسين ادريس ثم المرحومين على فهمى الكاشف ومحمد عزت . اما الحصر الكامل للوحـدات الجيولوجية التى تحمل المياه الجوفية فى معظم أو بالاحرى فى كل المساحة التى تشغلها مصر ، فضلا عن تحديد خصـائصها الهيـدروليكية والجيـوكيميائية وتوزيعها الجغرافى فقد كان من بين اهتمـامات المؤلف ومعاونيه من الاساتذة البحاث ومساعديهم فى معهد الصحراء فى الفترة منذ افتتاحه فى عام ١٩٥٠م حتى عـام ١٩٨٠ ويطيب لى أن أشـير الى مجموعة اخرى من الرواد اذكر منهم كمال فريد سعد ومحمد الشاذلى وابراهيم الفيومى وابراهيم حميدة ونبيل رفائيل ورفيق سالم . ولقد استعنت بفيض المعلومات التى أتيحت لى من المشـاركة معهم ومع غيرهم من البحـاث فى تجميع الخريطة الهيدروجيولوجية لمصر بمقياس رسم ١ : ٥ مليون — شكل أ . وبالنسبة لقائمة المصطلحات التى تخص تلك الخريطة فقد تم الاعتماد على الوثائق التى أقرت بمعرفة كل من اليونسكو واكساد ، مع اجراء عدد محدود من التعديلات التى كانت لها ضرورتها .

تبقى بعد ذلك حقيقة تتصـل بمسألة ندرة الخرائط الهيـدروجيولوجية فى مصر ومتاعب استثمار الارض وغزو الصحراء . فقـد أثيرت تلك المسألة خلال المؤتمر الأول لتنمية محافظات مصر الصحراوية الذى عقـد بمحافظة الوادى الجديد فى شهر سبتمبر من العـام الحـالى ، وكانت هناك توصية بضرورة مداركة الوضـع بأسرع وقت ممكن . ولعله تكون هناك خطوات فعالة وعملية لانجاز تلك الخرائط ، ولعله يكون هناك المزيد من تعضيد اكاديمية البحث العلمى والتكنولوجيا للجهود الحالية لمعهد المياه الجوفية ولعلنا نستطيع فى فترة زمنية قصيرة ان نتغلب على المصاعب التى نجمت عن تأخر ظهور هـذا النوع من الخرائط لمدة تزيد على خمسين عاما.

الوحدات الهيدروجيولوجية الاقليمية :

فى اطار مقياس الرسم الصـغير للخريطـة المقدمة (١ : ٥ مليون) ، تتضمن الخريطـة الهيدروجيولوجيـة لمصر خمسـة وحـدات رئيسية ، وقد تم تصنيف تلك الوحـدات طبقا لعدد من المعايير التى اعتمدتها اليونسكو واكساد والتى تشـمل بالدرجة الاولى الخصـائص الليتولوجيه (اى الطبيعه الصخريه للوسط) . ومدى توافر المياه الجوفية ، ثم مدى تجدد تلك المياه من عدمه ، وهى على النحو التالى :

١ — الوحـدة الاولى :

وتأخـذ اللون الازرق الغامق . وهى وحـدة هيدروجيولوجيه تتكون أساسا من صخور رملية وحصوية وتتميز فى عده مستويات مائيه ، والمياه متجدده بصفة عامه وعلى أعماق قليله ومتوسطة وفى حدود اقل من ٥٠٠ متر من سطح الارض .

٢ — الوحـدة الثانيـة :

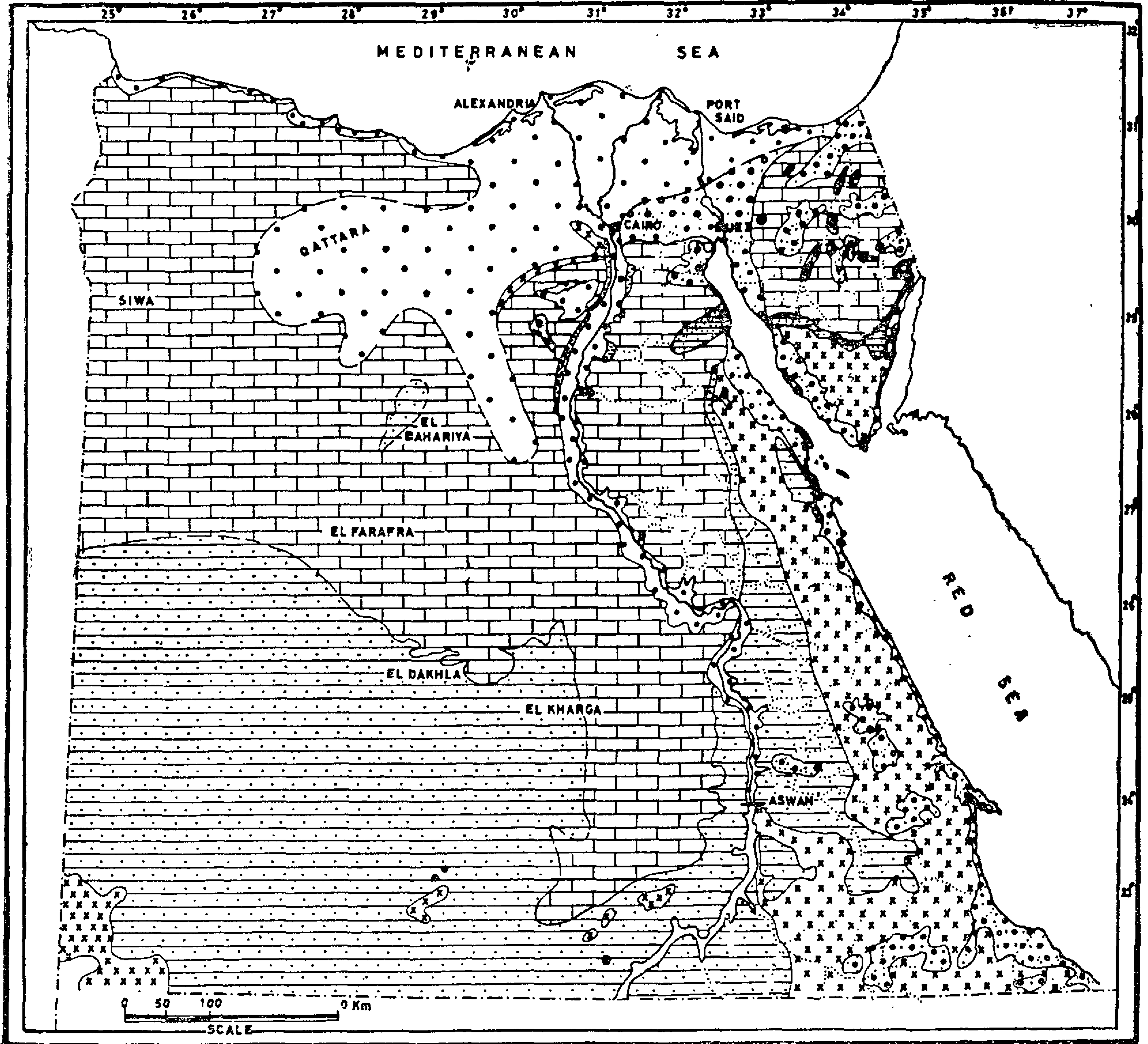
وتأخـذ اللـون الاصـفر وهى وحـدة هيدروجيولوجيـة تتكون أساسا من صـخور رملية وحصوية كالوحـدة السابقة ، وتتميز كذلك فى عده مستويات مائية ، غير أنها ليست متجـددة ، والمياه اذن من النـوع المتحفـر أى قديمه التغذيه وتوجد بصفه عامه على أعمـاق كبيرة تزيد على ٥٠٠ متر وقد تصل الى عـدة كيلومترات من سطح الأرض .

٣ — الوحـدة الثالثـة :

وتأخذ اللون الاخضر الفاتح ، وهى وحـدة هيدروجيولوجية تتكـون أساسا من الصـخور الجيرية المتشققة ، والمياه الجوفية بها تتواجد احيانا على شـكل جاثم Perched وتتواجد فى معظم الاحيان فى الشبكات الكارسـتية القديمة Paleokarst ، هـذا والتغذية الحالية لها تعتبر محدودة بصفة عامة .

٤ — الوحدة الرابعة :

وتأخـذ اللون البنى الفاتح ، وهى وحـدة هيدروجيولوجيـة تتكون أساسا من الصخور الرملية قليلة التماسك ، وهى تتميز بتواجـد مستويات مائية ذات طابع محلى وغير مسـتقرة بصفة عامة ، ومصادر التغذية المتاحة لها محدودة وغير منتظمة .



٥ ــ الوحــدة الخامســة :

وتأخذ اللون القرمزى Pink ، وهى وحدة هيدروجيولوجيــة تتكون أساسا من الصــخور الصــلبة المتشــققة من الأنواع الاندفاعيــة Volcanic والبلورية Crystalline والمتحولة Metamorphic . وقد تتكون من الصخور الطفلية المشــققة ، هى لا تتوافر بها موارد مائية جوفية بكميات ملحــوظة ومصادر التغذية محدودة وغير منتظمة او معدومة بالكامل .

وفى الاسطر التالية سوف نقــدم بالتفصيل خصــائص كل وحــدة من تلك الوحــدات الهيدروجيولوجية مع التركيز على الآتى :

- الامتــداد الجغرافى .
- الخصائص الليثولوجية .
- التأثر بالعوامل التكتونية .
- اتجاه حــركة الميــاه .
- نوعية المياه الجوفية المتاحة .

الوحـــدة الهيـــدروجيولوجيـــة الأولى (أزرق غامق) :

١ ــ تشغل تلك الوحدة مساحة تصـــل الى حوالى ٢٤٠ الف كيلـــو متر مربع وهى تغطى معظم المناطق المنخفضة فى حوض نهر النيـــل الى الشمال من اســـوان ، وتغطى منطقة الدلتا وتخومهاوكذا الامتداد الجغرافى لها شرقاوغربا. ويشـــمل الامتـــداد الشرقى مناطق المـــلاك والصالحيةوالمنايف والبردويل والعريش وساحل غزة . اما الامتداد الغربى فيشمل التحـــرير وغرب النوبارية ووادى الفارغ والمغرة وشرقى منخفض القطـارة ، وكل الســـاحل الشـــمالى الغربى حتى السلوم . هذا وتعتبر تلك الوحدة من اهم الوحدات الهيـــدروجيولوجية فى مصر نظرا لأن الميـــاه الجوفية الموجودة فيها دائمـــة التجدد وتعتمد فى تغذيتها على مصـــادر نشطة تشمل ما يلى :

ــ نهر النيل وفرعه وقنوات الرى والصرف أحيانا ، فضلا عن الرى بالغمر .

ــ مياه الامطار فى المناطق الســـاحلية ومـيـــاه الســـيول فى مجارى الوديان مثـــل وادى غزة ووادى العريش ووادى الجراولة ووادى الرمل ووادى الخروبة وغيرها .

ــ المياه المتسربة افقيا من الخزان الجـــوفى فى نهر النيل والدلتا خاصـــة فى الاتجاه الشـــمالى الغـــربى ناحيـــة وادى النطـــرون ومنخفض القطـــارة .

ــ المياه المتسربة رأســـيا من خزانات المـــاه الجوفيـــة العميقـــة (احتمال قائم فى بعض المواقع) .

٢ ــ المكونات الصخرية لتلك الوحدة يغلب عليها الطابع الرملى والحصـــوى ، وهى اما أن تكون رواسب نهـــرية او رواســـب دلتائية أو رواســـب شاطئيـــة وتتبـــع فى جملتها الزمن الجيولوجى الرابع Quaternary والزمن الثالث Tertiary ومن التكـــوينات الجيولوجيـــة السائدة فى تلك الوحدة نذكر ما يلى مرتبا حسب قواعد التتابع الطبقى Stratigraphy من اعلى الى أسفل .

ــ تكوين الكركار Kurkar Formation من الحجر الرملى الجيرى ويتبع الزمن الجيولوجى الرابع وهو واسع الانتشار فى شمال شرق سيناء (السمك من ٣٠ الى ٥٠ متر) .

ــ تكوين الاسكندرية Alexandria Formation وهو من الحجر الجيرى البطروخى ويتبع الزمن الجيولوجى الرابع وينتشر على طول الســـاحل الشمالى الغربى (السمك فى حدود حوالى ٧٠ متر) .

ــ تكوينات النيل القديمة وتكوينات ما قبل النيل Old Nile and Pre-Nile Formations وهى أيضـــا من الزمن الجيولوجى الرابـــع بالاضافةالى الزمن الجيولوجى الثالث،وهى من الرمل متوسط الحبيبات وغليظها والذى يختلط أحيانا مع الحصى ، وهى واســـعة الانتشار فى المنخفض الحالى لنهر النيل الى الشـــمال من اسوان وفى دلتا نهر النيل وتخومهـــا . هـــذه التكوينات تتحول شـــمالا أى فى اتجاه البحـــر المتوسط الى الرمـــل دقيق الحبيبات المختلط بالطفل (الســـمك فى المنخفض النيلى جنوبى القاهرة يصل الى حوالى ٢٠٠ متر تقل جنـــوبا ناحية اسوان،وعند القاهرة يتراوح السمك من صفر الى بضع عشرات من الامتار ، وفى وسط الدلتا يصل الى حوالى ٥٠٠ متر أما فى الشمال فيتجاوز السمك ١٠٠٠ متر) .

ــ تكوين المغـــرة Moghra Formation وهـــو أساسا من الحجـــر الرملى متوســـط الحبيبـــات ويتبـــع الزمن الجيولوجى الثالث وبصـــفة خاصـــة الميوســـين الأســـفل Late Tertiary-Lower Miocene هذا التكوين واســـع الانتشار فى النصـــف الشرقى لمنخفض القطارة وفى المنطقـــة بين القطارة ودلتا نهر النيـــل ثم بين القطـارة وســـاحل البحر المتوسط . ويتحول تكوين المغـــرة تدريجيا فى النصف الغربى لمنخفض القطـــارة الى الحجـــر الجيرى . (السمك فى حدود حوالى ٢٠٠ متر تزيد احيانا ليصل الى اكثر من ٩٠٠ متر) .

٣ ــ حـــول تأثر تلك الوحـــدة بالحركات الارضية يمكن الاشارة الى الآتى :

ــ فى حوض نهر النيل جنوبى القاهرة تتأثر الوحدة بعدد من الفوالق Faults التى تأخذ الاتجاه الشمالى الغربى ــ الجنوبى الشرقى وهى تقطع حوض النهر ذاته والهضـــاب المتاخمة له شرقا وغربا . وربما تلعب دورا مؤثرا فى احداث نوع من العلاقات الهيدرولوجية بين تلك الوحده والوحـــدات الهيـــدروجيولوجية المتـــاخمة لها وبصفة خاصـــة الوحـــدة الثالثة التى تشـــمل الصخور الجيرية المتشـــققة . وقد تلعب تلك الفوالق دورا فى قيـــام التسرب الافقى منها الى تلك الصخور المتشققة . هـــذا وقد تلعب نفس

تلك الفوالق دورا آخر فى تواجد شبه فواصل Sub-barriers بين حوض النيل فى الجنوب وحوض الدلتا فى الشمال .

— فى منطقة الدلتا وتخومها توجد منطقة حوضية Faulted Geosynclinal Trough وهناك تأخذ الفوالق كلا من الاتجاه الشمالى الشرقى والشمالى الغربى .

— فى شمال غرب سيناء يوجد انحدار تركيبى Homoclinal Slope يتجه ناحية الشمال والشمال الغربى .

— فى منطقة القطارة يوجد عدد من التموجات التركيبية Structural Undulations والميل العام للطبقات من النوع المعتدل ويأخذ بصفة عامة الاتجاه الشمالى والشمالى الغربى . هذا ويحد تلك الوحدة من الناحية الشرقية تكوينات البازلت الصماء (أو شبه الصماء) والمرتفعات التكتونية Tectonical Ridges المعروفة باسم أبو رواش والقطانية .

٤ — المياه الجوفية فى تلك الوحدة تتبع بصفة عامة الانواع الحرة وشبه المحصورة Free Water Table to Semiconfined والمستوى البيزومترى يتراوح فى حوض النيل ما بين ٨٥+م عند اسوان الى حوالى ١٥+م عند القاهرة وفى الدلتا ينخفض هذا المستوى الى اقل من ١+م فى الاقليم الساحلى للبحر المتوسط . أما فى منطقة القطارة فان المستوى البيزومترى للمياه الجوفية قد ينخفض الى اقل من ٥٠ مترا تحت سطح البحر . وبالنسبة للتغذية Recharge والتصريف Discharge فى تلك الوحدة يمكن تلخيص الوضع فيما يلى :

— فى حوض النيل بين اسوان والقاهرة يعتمد الخزان الجوفى بصفة اساسية فى التغذية على النهر ونظم الرى والصرف وتقدر التغذية السنوية بحوالى ٦ر٥ مليار متر مكعب يعود منها الى النهر ذاته فى بعض قطاعاته ويتسرب الى منخفض الفيوم عن طريق مقطع الهوارة ما مقداره ٥ر٣ مليار متر مكعب (يلاحظ ان قاع مقطع الهوارة يوجد عند منسوب ١٨ + م ، ومستوى الماء الجوفى فى نفس الموقع وفى بنى سويف يوجد عند حوالى ٢٠ + مترا ، أما مستوى سطح الماء فى بركة قارون فى منخفض الفيوم فيوجد عند حوالى ٤٤ مترا تحت سطح البحر) .

— فى منطقة الدلتا يعتمد الخزان الجوفى فى تغذيته على النهر ونظم الرى المتبعة والخزان الجوفى الجنوبى وتقدر التغذية السنوية بحوالى ٧ر٢ مليار متر مكعب أما المستغل منها والمتسرب والفاقد فيقدر بحوالى ٢ر٠ مليار متر مكعب . هذا الفاقد يتم فى المناطق الرطبة فى الاقليم **الساحلى للبحر المتوسط** وفى المنخفضات الصحراوية مثل وادى الطميلات شرقا ووادى النطرون غربا (يقدر بحوالى ٧٠ مليون متر مكعب فى السنة) . أما الجانب الأكبر من التسرب فيتجه أساسا الى تكوينات المغرة التى تشغل مساحة تصل الى حوالى ٦٠ الف كيلومتر مربع تقع الى الغرب من دلتا نهر النيل (مطلوب المزيد من الدراسة الاحصائية) .

— فى تكوينات المغرة التى تمتد من غرب الدلتا الى قرب الحافة الغربية لمنخفض القطارة تقدر التغذية السنوية بما يقرب من ٥٠٠ مليون متر مكعب وهى تأتى أساسا من الخزان الجوفى لدلتا نهر النيل . أما مناطق التصريف فتشمل أساسا منخفض وادى النطرون (العمق ٢٢ متر تحت سطح البحر) ومنخفض واحة المغرة (العمق ٣٠ متر تحت سطح البحر) ومنخفض القطارة (العمق يصل الى ١٤٩ متر تحت سطح البحر) . وهذا الفاقد يقدر بحوالى ٣٥٠ مليون متر مكعب سنويا (مطلوب المزيد من الدراسة الاحصائية) .

— فى المناطق الساحلية توجد تغذية محدودة للخزانات الجوفية وهى تعتمد على الامطار المحلية وأحيانا على السيول فى مجارى الوديان مثل وداى العريش ووادى الجراولة ووادى **الرمل ووادى الخروبة** . وتقدر التغذية السنوية بحوالى ١٠٠ مليون متر مكعب .

٥ — **حول نوعية المياه الجوفية** فى تلك الوحدة يمكن الاشارة الى الآتى :

— **فى حوض نهر النيل** جنوبى القاهرة المياه عذبة (ملوحة أقل من ٥٠٠ج/م) .

— **فى منطقة الدلتا** وتخومها توجد مياه عذبة وقليلة الملوحة (اقل من ١٠٠٠ ج/م) فى الاجزاء الجنوبية ، أما فى الاجزاء الشمالية فملوحة الماء تزيد على ٥٠٠٠ ج/م .

فى الاقليم الساحلى للبحر المتوسط توجد مياه شبه مالحة (أكثر من ٣٠٠٠ ج/م) .

— فى منطقة القطارة توجد بصفة عامة مياه مالحة (٥٠٠٠ ج/م فأكثر) ومياه مالحة جدا (ملوحة اكثر من ٣٠٠٠٠ ج/م) . وأحيانا توجد جيوب محدودة بها مياه عذبة وقليلة الملوحة .

فى الوقت الحالى يجرى استخدام المياه الجوفية المتاحة بتلك الوحدة فى مناطق حوض النيل (قبلى وبحرى) وفى التخوم خاصة فى مناطق الاستصلاح الجديدة حول الدلتا ، وفى الاقليم الساحلى للبحر المتوسط . وفى النواحى الصناعية والتعدينية يجرى استخدام المياه الجوفية فى مناطق وادى النطرون والقطارة وبصفة خاصة فى مجال البترول . هذا ولا يوجد فى الوقت الحالى احصاء دقيق لكميات المياه الجوفية المستغلة من تلك الوحدة ، ولكن من المؤكد أن هناك فاقد كبير قد يتجاوز المليار من الامتار المكعبة يضيع فى المنخفضات الصحراوية والساحلية بدون استغلال . وتلك قضية ينبغى أن نعطيها المزيد من الاهتمام .

الوحدة الهيدروجيولوجية الثانية (لون أصفر) :

١ ــ تغطى تلك الوحدة معظم المساحة التى تشغلها مصر (حوالى مليون كيلومتر مربع) وقد تعرضت فى مناطق محدودة من جنوب سيناء والصحراء الشرقية للازالة بفعل الحركات الأرضية وعوامل التعرية خلال الأزمنة الجيولوجية المتعاقبة وبصفة خاصة فى الزمن الثالث Tertiary وهى تظهر على السطح فى مساحات واسعة قد تصل الى حوالى ثلث مليون كيلومتر مربع فى الصحراء الغربية جنوبى خط عرض ٢٨ درجة ، كما تظهر فى المنطقة التى تحيط ببحيرة السد العالى وفى نهر النيل بين أسوان وثنية قنا ثم تمتد ناحية الشمال الشرقى حتى قرب جبل غارب فى الصحراء الشرقية . بعد ذلك تظهر تلك الوحدة فى منخفض وادى عربة الى الشمال من جبل غارب . وفى سيناء يقتصر ظهور الصخور المكونة لتلك الوحدة على سطح الارض على حزام ضيق فى جنوب سيناء يمتد من أم بجمة التى تطل على خليج السويس وسرابة الخادم وحتى رأس النقب التى تطل على خليج العقبة . هذا وتظهر نفس تلك الصخور فى مناطق متناثرة من شمال ووسط سيناء حيث توجد التراكيب القبوية Anticlinal Ridges بالنسبة لما تحت السطح أمكن تأكيد وجود الصخور المكونة لتلك الوحدة فى كثير من الآبار المحفورة فى سيناء والصحراء الغربية وحوض نهر النيل جنوبى قنا . وهى توجد على أعماق متفاوتة تتراوح من بضع مئات من الأمتار الى بضع آلاف من الامتار من سطح الارض . وفى جميع الأحوال سواء فيما يختص بالوضع فوق سطح الارض أو تحته ، هناك ثمة ما يدل على استمرارية الامتداد الجغرافى لتلك الوحدة ليس فقط فى اطار المساحة التى تشغلها مصر ولكن فى مساحات أخرى واسعة فى شرق البحر المتوسط وفى السودان جنوبا وليبيا غربا . مثل الوحدة الهيدروجيولوجية السابقة تعتبر تلك الوحدة على درجة كبيرة من الأهمية وقد تتفوق عليها كثيرا اذا ما أخذنا فى الاعتبار حجم المخزون المائى الذى يصل الى حوالى ٢٠٠ ألف مليار متر مكعب حسب أقل التقديرات تفاؤلا . فى مصر وفى البلاد المجاورة تمتد تلك الوحدة فى مناطق قاحلة أى ان تغذيتها من الامطار المحلية ومن الانهار الدائمة والموسمية تعتبر جد قليلة اذا ما قورنت بحجم المياه المختزنة (قد لا تتجاوز فى أحسن التقديرات ار٠٪) . هذه المياه اذن من النوع المتحفر Fossil Water أى النوع غير المتجدد بصفة عامة .

٢ ــ المكونات الصخرية لتلك الوحدة من الحجر الرملى اساسا وتتخللها طبقات طفلية على شكل عدسات يزداد سمكها وعددها كلما اتجهنا شمالا وقد تتخللها طبقات من الحجر الجيرى والمتبخرات أحيانا . ويتراوح سمك تلك المكونات ما بين أقل من ٥٠٠ متر فى الاجزاء الجنوبية من مصر وكذا فى الخارجة الى اكثر من ٣٥٠٠ متر فى الأحزاء التى تقع الى الغرب من واحتى الداخلة والفرافرة . وهى تتبع كل من الزمن الجيولوجى الاول والزمن الجيولوجى الثانى ويطلق عليها أحيانا تكوينات الحجر الرملى النوبى أو التكوينات النوبية المعقدة . وفى الأجزاء الشمالية من مصر تتميز تلك التكوينات فى عدد من الوحدات التى وضعت لها اسماء محلية بمعرفة شركات البترول مثل خريطة ، وقد لا يكون من الضرورى التعرض لتفصيلاتها من ناحية التتابع الطبقى Stratigraphy.

ترقد المكونات الصخرية لتلك الوحدة فوق صخور القاعدة المعقدة Basement Complex وهى من الصخور الصلبة التى غالبا ما تكون متبلورة Hard Crystalline Rocks كما يرقد فوقها فى معظم الاجزاء من مصر شمالى خط العرض ٢٨ درجة نوع آخر من التكوينات غالبا ما تكون من الصخور الجيرية المتشققة واحيانا تكون من الصخور الطفلية . وليس من شك فى ان الوضع الجيولوجى لتلك الوحدة ، فضلا عن خصائصها الصخرية Petro-physical والذى يحدد الحالة التى تكون عليها المياه

الجوفية وبصفة خاصة حالة الحصر او الحبس Confinement أو الحالة الحرة Phreatic.
هذا من ناحية ومن ناحية أخرى فان امتداد الأجزاء المكشوفة من تلك الوحدة فوق مساحات واسعة في مصر وفى خارجها كان له تأثير مباشر على عمليات التغذية خلال الأزمنة الجيولوجية المختلفة وبصفة خاصة خلال العصر الجليدى المتأخر اى منذ ما يقرب من ٤٠ الف عام. وربما كان امتداد تلك الوحدة فى المناطق المطرة حاليا من عوامل التغذية فى الوقت الحالى ولكن مع البطء الشديد لحركة المياه الجوفية والتى تقدر بحوالى ١٤ متر فى العام فان نقطة الماء التى تسقط فوق تشاد مثلا تحتاج لحوالى ١٠٠ الف عام لكى تصل الى مصر .

٣ — حول تأثر تلك الوحدة بتحركات القشرة الارضية والتراكيب الجيولوجية يمكن الاشارة الى أن تلك الوحدة تنتظم فى عدد من الأحواض الاقليمية Regional Basins مثل حوض الكفرة وحوض الصحراء الغربية وحوض شرق البحر المتوسط الذى يشمل شبه جزيرة سيناء. وعلى الرغم من ان كل من تلك الاحواض ينتظم هو الآخر فى عدد من الأحواض شبه الاقليمية Subregional Basins مثل حوض الداخله وحوض ابوالغرادق وحوض قارون وحوض التيه وغيرها هذا فضلا عن الاحواض المحلية Local Basins على الرغم من كل هذا ، وعلى الرغم من تأثر تلك الاحواض بالفوالق الطولية والمستعرضة وكذا النتوءات البركانية ، فانه يصعب من وجهة النظر الجيولوجية المحضة تصور وجود فواصل صماء بين تلك الاحواض بعضها بالبعض الاخر. هناك أيضا الانحدار التركيبى لتلك الوحدة ناحية الشمال والشمال الشرقى فهو يلعب دورا رئيسيا فى تحديد الاتجاهات الاقليمية لسريان المياه الجوفيه . وفى شبه جزيرة سيناء على وجه الخصوص يلاحظ انه بالاضافة الى اتجاهات السريان الاقليمية ناحية الشمال تؤثر الأخاديد التى تحد شبه الجزيرة من الشرق مثل اخدود العقبة والبحر الميت ومن الغرب مثل اخدود السويس فى حدوث تغييرات محلية .

٤ — المياه الجوفية فى تلك الوحدة تتبع بصفة عامة الأنواع المحصورة Confined وتظهر على السطح فى مواقع كثيرة على شكل عيون طبيعية مثل الواحات ، وتدل الخرائط المتاحة عن ضغوط المياه فى تلك الوحدة على انها فى حالة حركة ، وان هذه الحركة جد بطيئة ، وأن تلك الحركة تأخذ فى الصحراء الغربية الشمالى الشرقى تحت ميل هيدروليكى مقدارة حولى ٠ر٥٪ ، وفى شبه جزيرة سيناء هناك ميل هيدروليكى فى الاتجاه الشرقى ناحية صحراء النقب والبحر الميت ، وهناك ميل آخر فى الاتجاه الغربى ناحية عيون موسى . هذا فضلا عن الاتجاه الاقليمى ناحية الشمال . وبالنسبة للصحراء الشرقية لا توجد معلومات كافية حول ضغوط المياه وحول اتجاه السريان . هذا وقد أشرت فى فقرة سابقة الى ان حجم المياه المختزنة فى تلك الوحدة يتجاوز ٢٠٠ ألف مليار متر مكعب ، ويدور فى الوقت الحالى جدل حول حجم التغذية التى تصل اليها سواء من الأمطار المحلية مثل جنوب سيناء أو من الامطار التى تسقط فى مناطق نائية خارج الحدود وبصفة خاصة فى الجنوب الغربى أو من أحواض كبيرة للمياه الجوفية تقع كذلك خارج الحدود فى الجنوب وفى الغرب ، ومع هذا فان هناك اتفاق عام على أن حجم التغذية الحالية لا يعتبر شيئا مذكورا اذا ما قورن بحجم المياه المختزنة .

هذا ويتم تصريف المياه من تلك الوحدة سواء بشكل طبيعى عن طريق العيون الكثيرة التى تنتشر فى الواحات الجنوبية والوسطى وفى بعض جهات الصحراء الشرقية وسيناء حيث تتكشف الصخور المكونة لها ، وكذلك عن طريق التسرب الراسى الى الصخور الجيرية المتشققة التى ترقد فوقها . هذا ويتم تصريف تلك المياه صناعيا بحفر الآبار العميقة فى الواحات ومنطقة القطارة (على سبيل المثال بئر قفار وبئر غزلات) وفى الصحراء الشرقية مثل آبار وادى اللقيطة وفى سيناء مثل آبار نخل ودرج وأبو حمص وعيون موس والحمره . وفى تلك الآبار يصل الماء الى سطح الأرض سواء بالتدفق الذاتى او باستعمال المضخات . ويتوقع مع استمرار سحب الماء من

تلك التكوينات ان يتوقف التدفق الذاتى من الآبار خلال فترة زمنية تقل عن مائة عام ويتوقف طول تلك الفترة على الموقع الجغرافى وعلى حجم المياه المسحوبة. وهناك فكر سائد يقرر ان هناك تصريف طبيعى للمياه الجوفية من تلك الوحدة فى منطقة القطارة ويقدر حجم هذا التصريف بحوالى ١٠٠ مليون متر مكعب فى العام (حوالى ٣٠٠ الف متر مكعب فى اليوم) ، ولكن هناك ثمة حقائق تتعارض مع هذا الفكر وتشمل :

ــ وجود طبقات سميكة (أكثر من ألف متر فى معظم جهات المنخفض) تفصل التكوينات الجيولوجية المكونة لتلك الوحدة عن قاع المنخفض منها طبقات تتكون من الطفل قليل النفاذية .

ــ عدم استمرار معظم الفوالق التى تقطع تكوينات تلك الوحدة الى قاع المنخفض على السطح ، وهذه الفوالق يفترض أن تقوم بتوصيل الماء الجوفى ذو الضغط المرتفع الى سطح الارض (ربما تكون هناك بعض الفوالق لها طابع الاستمرار ولكن يقتصر وجودها على مناطق محدودة) .

ــ اكتشاف العديد من مكامن النفط فى منطقة القطارة وما حولها فى الكثير من الطبقات ، بعضها يتخلل القطاع الجيولوجى المكون لتلك الوحدة مثل تكوين العلمين وبعضها الآخر يوجد فوقها مثل تكوين ابو رواش .

٥ ــ حول نوعية المياه الجوفية فى تلك الوحدة يمكن الاشارة الى الآتى :

ــ فى الاجزاء الجنوبية والوسطى من منطقة الصحراء الغربية توجد مياه عذبة بصفة عامة (ملوحة اقل من ١٠٠٠ جزء فى المليون) أما فى منطقة القطارة فالمياه الجوفية من النوع شبه المالح بصفة عامة (ملوحة أكثر من ٢٠٠٠ جزء فى المليون) . وفى المنطقة شمالى القطارة توجد مياه عالية اللوحة بصفة عامة (ملوحة أكثر من ٢٠ الف جزء فى المليون) . هذا النطاق المالح يمتد شرقا الى الاجزاء الجنوبية من منخفض الفيوم ووادى الريان . هذا والمياه فى معظم الصحراء الغربية ذات حرارة عالية تتراوح من ٣٠ درجة مئوية فى الاجزاء الجنوبية الى ٧٥ درجة مئوية فى بئر غراب فى غرب منخفض القطارة (العمق حوالى ٢٠٠٠ متر من سطح الارض) .

ــ فى الصحراء الشرقية لا توجد معلومات كثيرة ، والمياه بصفة عامة ذات ملوحة عالية أكثر من ٢٠٠٠ جزء فى المليون) والحرارة متوسطة الارتفاع (فى حدود ٣٠ درجة مئوية) .

ــ فى شبه جزيرة سيناء المياه الجوفية ذات ملوحة عالية (أكثر من ٢٠٠٠ جزء فى المليون) والحرارة أيضا متوسطة الارتفاع .

الوحدة الهيدروجيولوجية الثالثة (لون أخضر فاتح) :

ــ **تشغل تلك الوحدة مساحة تصل الى ٥٠٠** ألف كيلو متر مربع من سطح الارض فى مصر حيث تكون ما نعرفه باسم الهضاب التركيبية مثل هضبتى التيه والعجمة فى سيناء وهضبة المقطم وعتاقة والجلالة القبلية والبحرية والمعزة فى الصحراء الشرقية ثم هضبة سن الكداب وكركر ودنجل وابو طرطور والقس أبو سعيد والمار ماريكا فى الصحراء الغربية . وفى تلك الهضاب يرتفع سطح الارض أحيانا لأكثر من الف متر فوق سطح البحر . هذا وتظهر كذلك الصخور المكونة لتلك الوحدة فى التلال التركيبية فى شمال سيناء مثل المغارة ويعلق والحلال وعرايف الناقة وغيرها . هذا وقد تم التعرف على المكونات الصخرية التى تتبع تلك الوحدة ايضا على أبعاد متفاوتة من سطح الارض وذلك فى الآبار التى تم حفرها للبترول وللمياه الجوفية .

وعلى الرغم من الامتداد الجغرافى الواسع لتلك الوحدة فى مصر الا انها حتى الآن لم تدرس بدرجة لائقة من الناحية الهيدروجيولوجية . وفى الوقت الحالى يجرى وضع خطة لاستيفاء المعرفة حول امكانات المياه الجوفية بها . ويمكن فى هذا الصدد الاشارة الى ان عددا من عيون الماء الطبيعية تتفجر من صخور تلك الوحدة مثل عين الجديرات فى سيناء وعيون حلوان فى القاهرة وعيون كركر ودنجل وعامور فى جنوب الصحراء الغربية ثم عيون سيوه (أكثر من ٢٠٠ عين) فى شمال الصحراء الغربية .

المكونات الصخرية لتلك الوحدة يغلب عليها الطابع الجيرى وهى ذات أصل بحرى ثم هى متشققة بصفة عامة Fissured . وهذا التشقق ينتظم عادة فى شكل شبكات كارستية قديمة Paleokarst ومن المؤكد أن وجودها يرتبط بالأمطار القديمة .

تتبع تلك المكونات الصخرية كل من الزمن الجيولوجى الثالث Tertiary والزمن الجيولوجى الثانى Mesozoic وقد يتجاوز سمكها ثلاثة آلاف متر وبصفة خاصة فى المناطق الحوضية . هذا وتتخللها احيانا طبقات طفلية ودولوميتية غير انها سريعة التغير . ومن هذه الطبقات نذكر الطين الاسناوى بين تكوينات الزمن الثالث والزمن الثانى وتكوينات الضبعة الطينية فى منتصف الزمن الثالث . لذلك ، وعلى الاقل فى الوقت الحالى ، سوف نعالج هذا القطاع كوحدة متكاملة . هذا من ناحية ، ومن ناحية أخرى ، يتميز هذا القطاع فى عدد من التكوينات الاستراتجرافية Stratigraphic Formations وهى قد تتماثل أو تختلف طبقا للاحواض الترسيبية القديمة ومنها :

– تكوين المارماريكا فى الصحراء الغربية وهو من العصر الميوسينى وقد يتجاوز سمكه ٣٠٠ متر) .

– تكوينات نخل (بضم الميم والخاء) وقارة شوشان وهما من الميوسين .

– تكوينات المقطم والعجمة وطيبة وابولونيا من العصر الايوسينى .

– تكوينات خومان والحلال وابو رواش والجلالة من العصر الكريتاوى العلوى .

– تكوينات العلمين وشلتوت والمعمورة من العصر الكريتاوى الاسفل .

– تكوينات المساجد ورمان من العصر الجوراوى .

٣ – حول تأثر تلك الوحدة بالعوامل التكتونية يمكن الاشارة الى وجود عدد من الاحواض التركيبية التى تحددت معالمها فى ضوء عمليات الكشف البترولية وبصفة خاصة خلال ربع القرن الماضى .

وبدون الدخول فى تفصيلاتمعقدة ، نذكرمن تلك الاحواض ما يلى :

– أحواض سيناء الوسطى والشمالية خلال الزمن الجيولوجى الثانى والثالث (سمك الطقاع الجيولوجى قد يصل الى ٤٠٠٠ متر) .

– حوض الدلتا (على الرغم من أن سمك القطاع الجيولوجى قد يتجاوز ٧٠٠٠ متر ، الا أن المكونات الجيرية تعتبر قليلة للغاية . وعلى كل حال فالمعلومات المتاحة قليلة) .

– حوض مطروح وأبو الفرادق (الجوراوى والكريتاوى الاسفل ، حيث يصل سمك القطاع الجيولوجى المجمع لأكثر من ٥ الف متر ، نسبة كبيرة منها من الصخور الجيرية) .

– حوض دهب ومرير بين الضبعة والاسكندرية (الكريتاوى الاسفل ، حيث سمك القطاع الجيولوجى قد يصل الى ٤٥٠٠ متر) .

– حوض شوشان جنوب سيدى برانى وحوض الجندى فى الفيوم وحوض ابو الفرادق (الكريتاوى العلوى حيث يصل سمك القطاع الجيولوجى المجمع الى اكثر من ٧٠٠٠ متر) .

– حوض الجندى فى الفيوم (الايوسين ، حيث سمك القطاع الجيولوجى يصل الى اكثر من ٦٠٠٠ متر) .

هذه الأحواض وغيرها ، يمكن التأكيد على انها فى فترات جيولوجية قديمة كانت احواضا للمياه الجوفية ، يدل على ذلك انتشار المسامية الثانوية التى تتمثل فى الشقوق وفى الشبكات الكارستية القديمة ، ولكن لا توجد معلومات كثيرة عن اوضاع المياه الجوفية فيها .

٤ – حول الاوضاع الهيدروجيولوجية والهيدروكيميائية للتكوينات الجيرية المتشققة فى مصر ، هنالك ندرة فى المعلومات ولكن يمكن الاشارة الى الآتى :

— وجود العديد من عيون الماء الطبيعية التى تتفجر منها فى اكثر من موقع فى مصر يؤكد احتمالات جيدة .

— وجود المياه الجاثمة Perched فى تلك التكوينات يؤكد وجود اكثر من مستوى مائى .

— ملوحة الماء تعتبر مرتفعة بصفة عامة فالمياه اما أن تكون شبه مالحة Brackish أو مياه مالحة .

— التغذية الحالية لتلك التكوينات اما أن تعتمد على الامطار القليلة التى تسقط فوق الهضاب واما أن تعتمد على التسرب الرأسى من التكوينات القديمة مثل تكوينات النوبى المعقدة . وفى كل الأحوال تعتبر التغذية الحالية جد منخفضة .

— بالنسبة للتصريف هناك العيون الطبيعية مثل عيون واحة سيوة (اكثر من ٢٠٠ عين تعطى تصرفا يصل الى ٤٠٠ الف متر مكعب فى اليوم) وهناك عيون حلوان جنوبى القاهرة ، وهناك عين ديرّ القديس انطونيو ، وهناك عين الجديرات فى شمال شرق سينا . يتم كذلك تصريف المياه من تلك التكوينات عن طريق حفر الآبار وهى قليلة نسبيا ونراها فى هضبة المارماريكا جنوبى مطروح وفى هضبة التيه فى سيناء ، وفى اماكن اخرى قليلة .

الوحدة الهيدروجيولوجية الرابعة (اون بنى فاتح) :

١ — الصخور المكونة لتلك الوحدة تنتشر فى مناطق متفرقة من مصر ، وهى اكثر تواجدا فى المناطق الساحلية لخليج السويس وخليج العقبة وساحل البحر الأحمر . هذا وتوجد تلك الصخور فى المنطقة بين القاهرة والسويس وامتدادها فى الشمال الشرقى فى شمال سيناء . اخيرا وليس آخرا تتواجد تلك الصخور فى مجارى وادى العريش فى وسط وشمال سيناء وفى مجرى وادى فيران ووادى القاع وغيرهما فى جنوب سيناء .

تعتمد تلك الصخور فى تغذيتها بالمياه على الأمطار المحلية وعلى مياه السيول الموسمية فى مجارى الوديان واحيانا على التسرب الأفقى من خزانات المياه الجوفية التى تتلاصق معها . ونظرا لان حجم التساقط المطرى فى مصر من النوع المحدود ، ونظرا لأن السيول تحدث متقطعة وموسمية (مرة كل حوالى خمس سنوات) ونظرا لان خزانات المياه الجوفية التى تتلاصق مع تلك الصخور من النوع قليل الاهمية — فى حدود المعرفة المتاحة فى الوقت الحالى — نظرا لكل هذا فان امكانات تلك الوحدة الهيدروجيولوجية تعتبر محدودة وقد تكون لها بعض الأهمية على المستوى المحلى فقط .

٢ — الصخور المكونة لتلك الوحدة تتكون أساسا من الحصى والرمل المتفكك أو قليل التماسك وهى من الانواع الفرينية التى تمثل حشو المجارى المائية او الوديان . هذا وفى بعض المواقع تتكون الصخور من الرواسب البحرية قليلة العمق مثل المارل الرملى ، هذا فضلا عن رواسب الكثبان الهوائية . هذه المجموعة المتنوعة من الصخور تتبع الزمن الجيولوجى الرابع ونهاية الزمن الجيولوجى الثالث ، ويصل سمكها الى حوالى ٥٠٠ متر ، وهى كما ذكرنا تعتمد فى تغذيتها على مصادر محدودة وقليلة الأهمية .

٣ — حول تأثر تلك الوحدة بالعوامل التكتونية يمكن التركيز على عدد محدود من النقاط :

— فى شبه جزيرة سيناء هناك انحدار تركيبى عام ناحية الشمال (من حوالى ١٠٠٠ متر فوق سطح البحر الى ما دون منسوب سطح البحر) . هذه الظاهرة تعمل على التحكم فى السريان السطحى للمياه فى نفس هذا الاتجاه . وهذا الوضع يعطى بعض الأهمية للمكونات الصخرية لتلك الوحدة التى تنتشر فى الشمال الغربى والتى تغطيها الرواسب الهوائية (الكثبان) ويمكن الاشارة على سبيل المثال لا الحصر الى تكوينات الميوسين الرملية — والاوليجوسين الحصوية . فى سيناء أيضا تعمل الفوالق التى تسبب أخدود السويس وأخدود العقبة على تكوين بعض المناطق الحوضية المحلية مثل حوض

وادى القاع قرب الطور . مثل تلك الاحواض قد تصل قدرتها الانتاجية الى ٣٠ الف متر مكعب من الماء فى اليوم . ايضا عوامل الطى فى شمال سيناء تكون عددا من الالتواءات المقعرة Synclines وهذه تكون احواضا محلية للمياه الجوفية .

– فى المنطقة الساحلية للبحر الاحمر وخليج السويس توجد جيوب تملؤها مكونات تلك الوحدة مثل وادى غوايبة جنوبى جبل عتاقة ومثل وادى حوضين قرب راس بناس . وهذه الجيوب تمثل احواضا محلية للمياه الجوفية . فى نفس تلك المنطقة الساحلية تعمل الفوالق على تكوين اخاديد محلية وهى تكون بيئات صالحة لتكوين احواض المياه الجوفية مثل حوض شجر قرب راس غارب .

– فى المنطقة بين القاهرة والسويس ، توجد جيوب تكتونية قليلة وخصوصا فى المناطق شمالى هليوبولس حيث توجد مياه جوفية محدودة الأهمية فى التكوينات الصخرية مثل الحصى والرمل من عصر الأوليجوسين .

٤ – حول الأوضاع الهيدروجيولوجية والهيدروكيميائية لتلك الوحدة يمكن الاشارة الى ان المياه القليلة بها توجد بصفة عامة تحت ظروف حرة Phreatic وتعتمد فى تغذيتها على الأمطار وعلى مياه السيول واحيانا على التسرب الافقى من خزانات أخرى ملاصقة لها. والمياه بصفة عامة شبه مالحة Brackish او عالية الملوحة ، وامكاناتها محدودة .

الوحدة الهيدروجيولوجية الخامسة (لون قرمزى) :

١ – من ناحية التوزيع الجغرافى تتواجد تلك الوحدة فى جنوب سيناء حيث تكون القمم الجبلية المرتفعة (بعضها اكثر من ٢٠٠٠ متر فوق منسوب سطح البحر) . وتتواجد ايضا فى مجموعة سلاسل جبال البحر الأحمر وخليج السويس . وهى تظهر فى منطقة بحيرة السد العالى وكذلك فى مناطق صغيرة ومتفرقة بين تلك البحيرة وجبل عوينات فى الصحراء الغربية. هذا وتظهر كذلك مكونات تلك الوحدة على شكل نتوءات او على شكل طبقى فى المناطق المحيطة بدلتا نهر النيل فى الجنوب عند أبو زعبل فى الشرق وعند أبو رواش وجبل الحديد وجبل قطرانى فى الغرب ، وكذلك فى مناطق متفرقة بين القاهرة والسويس . ايضا تظهر مكونات تلك الوحدة فى بعض الوديان التى تقطع الهضاب المحيطة بنهر النيل جنوبى القاهرة فى الناحية الشرقية ، فهى توجد بين حلوان وجنوبى الصف ، وفى الناحية الغربية توجد نفس تلك التكوينات بين أبو رواش وجنوبى اللاهون . هذا بالنسبة للتوزيع الجغرافى لتلك الوحدة فوق سطح الارض ، أما بالنسبة للتوزيع تحت سطح الأرض فهى اكثر انتشارا وعلى اعماق متفاوته قد تصل الى بضع آلاف من الامتار . على الرغم من التوزيع الجغرافى الكبير لتلك الوحدة الا انها تعتبر اقل الوحدات الهيدروجيولوجية اهمية فى مصر . هذا وقد يمكن فى المستقبل ، عند اتمام المزيد من الدراسة لتلك الوحدة ، ان تظهر لها بعض الأهمية ولكنها فى كل الأحوال سوف تكون محدودة .

٢ – المكونات الصخرية التابعة لتلك الوحدة الهيدروجيولوجية تتميز فى نوعين اساسيين .

– النوع الصلب Hard Rocks ويشمل الأنواع المتبلورة Crystalline والانواع المتحولة Metamorphic وكذلك الانواع البركانية Volcanic . هذه الانواع هى الاكثر انتشارا والاكثر ارتفاعا وتقطعها مجارى الوديان هذا فضلا عن الشبكات المعقدة من الفوالق . وهى بصفة عامة تكون الأساس Basement الذى ترقد فوقه الصخور المكونة للوحدة الهيدروجيولوجية الثانية (لون أصفر) وهى تميل بصفة عامة ناحية الشمال والشمال الغربى . هذه الصخور الصلبة تتبع أساسا عصر ما قبل الكامبرى (ما قبل الزمن الأول) ، وبعض الانواع التابعة لها من عصر الأوليجوميوسين (الزمن الثالث) .

ـ الأنواع الرسوبية Sedimentary وتتكون اساسا من الطفل المتماسك ، الذى يتواجد معظمه فى حوض نهر النيل والدلتا ويتبع عصر البليوسين (الزمن الثالث) هذا الطفل يكون الاساس الذى يرقد فوقه الخزان الجوفى فى نهر النيل الى الشمال من اسوان وفى الدلتا.

وهذا الخزان يعتبر من توابع الوحدة الهيدروجيولوجية الاولى (لون ازرق غامق) .

٣ ــ حول تأثير تلك الوحدة بالعوامل التكتونية يمكن الاشارة الى ان عمليات الرفع الكبيرة Rising التى حدثت فى نهاية العصر الايوسينى وبداية العصر الأوليجوسينى هى التى كونت السلاسل الجبلية فى جنوب سيناء والبحر الاحمر وهى التى أحدثت عمليات التصدع Faulting وعمليات النشاط البركانى وتكوين الجدد Dykes كل هذه العوامل تعتبر ملائمة لأن تجعل من الصخور الصلبة التى تنتشر فى المناطق المشار اليها خزانات جيدة للمياه الجوفية . ولكن مع ندرة الامطار التى تسقط فوقها فى الوقت الحالى جعلت تغذية تلك الخزانات تكاد تكون منعدمة. يضاف الى ذلك ، ان الانحدار السريع للسطح ناحية البحار المحيطة جعل امكانية تفريغ تلك الخزانات تأخذ شكلا حادا . اخيرا وليس آخرا تعرض الصخور الصلبة للنشاط التكتونى المتعاقب Successive Tectonic Activity ربما ادى الى انسداد المجارى المائية فى عدد من الفوالق .

هذا بالنسبة للصخور الصلبة ، اما بالنسبة للصخور الرسوبية فان تكوين الخليج الضيق فى منخفض نهر النيل بين القاهرة واسوان خلال العصر البليوسينى ، ثم ما أعقب ذلك من تراجع الخليج وتفريغه من الماء المالح وملئه بعد ذلك بالرواسب الحصوية والرملية والماء العذب ــ كل ذلك تحكمه الانشطة التكتونية .

٤ ــ حول الأوضاع الهيدروجيولوجية والهيدروكيميائية لتلك الوحدة ، يمكن الاشارة فى حدود المعرفة الحالية الى ان الامكانات المائية تعتبر محدودة للغاية وقد تكون أحيانا منعدمة ، أولا بسبب ندرة الأمطار التى تسقط فوقها ، وثانيا بسبب عدم انتظام شبكات الفوالق التى تقطعها والتى تحكم بالدرجة الاولى تكوين المسامية الثانوية Secondary Poroesity. واكرر انه مع المزيد من الدراسة سوف يكون بالامكان التعرف على حقيقة امكانات المياه الجوفية فى تلك الوحدة .

اقتراح
تحسين المواصلات فى مدينة القاهرة *

دكتور مهندس عبد العزيز العروسى **

زاد عدد سكان القاهرة فى السنين الأخيرة زيادة كبيرة ، وامتدت أطراف المدينة ، واتسع العمران بها واكتنفتها المصانع ، وازداد دولاب الاعمال بها حركة ونشاطا ، وتسبب عن ذلك ان ازدحمت بها وسائل النقل ازدحاما شديدا ، وزادت فيها حركة السيارات زيادة كبيرة . وسيتضاعف عددها فى السنين القلائل القادمة متى تيسر استيرادها . وستتسع أطراف المدينة اكثر من الآن متى نشطت حركة البناء بتوافر الخشب والحديد . وطالما أن القاهرة هى مقر الحكومة المركزية وتبعا لهذا مجمع النشاط التجارى والصناعى والادارى والتعليمى فان اضطراد زيادة عدد السكان وزيادة العمران امر لا مفر منه ، وستزداد المواصلات بذلك صعوبة وبطأ يوما عن يوم . الامر الذى يعرقل انجاز الاعمال ويدعو الى ارتباكها . وما دام ليس لدى أولى الامر النية على توزيع السلطات الحكومية على الأقاليم ، الامر الذى يخفف الازدحام فى القاهرة تخفيفا كبيرا ويسبب انتعاش الاقاليم ، فلابد من العمل على ايجاد حل عملى لمشكلة المواصلات فى مدينة القاهرة .

حلت هذه المشكلة فى العواصم الأوربية الكبرى من قديم بمد خطوط الترام السريعة فى انفاق تحت الارض او بانشاء سكك سفلية مغطاة على طول الشوارع ، ونظرا لضعف تربة القاهرة وتشبعها بالمياه الجوفية فان هذا الحل يكلفنا هنا أموالا باهظة ويعرض سلامة المنازل للاخطار .

وهناك فكرة بالغاء خطوط ترام القاهرة ، وتسيير عدد كبير من الاوتوبيسات ، او الترولىبوسات الكهربائية بدلا عنها . وهذه الفكرة ، وان كانت تحل مشكلة ازدحام المركبات بمن فيها من الركاب ، الا إنها تزيد من ازدحام شوارعنا الضيقة بالسيارات ، بالاضافة الى الزيادة الكبيرة المنتظرة فى السيارات الخاصة ، وسيارات نقل البضائع فينشأ عن هذا الازدحام الشديد كثرة الحوادث وبطء المرور .

والحل العملى الوحيد ، هو أن ننشىء سككا علوية فى بعض الشوارع الرئيسية لخطوط ترام سريعة لا تقف قطاراتها الا فى ملتقى المواصلات الرئيسية ، كى تربط اطراف القاهرة بوسطها ارتباطا سريعا مريحا .

الخط الأول : يبدأ من مصانع شبرا البلد ، مخترقا شارع شبرا ، مارا بالمحطات : دوران روض الفرج ، فميدان باب الحديد ، حيث يتصل بخط المترو ، وخط المطرية بعد كهربته ، فالاسعاف ، فميدان الاسماعيلية ، فالقصر العينى . ومن هناك يعبر جزيرة الروضة ، ونهر النيل ، الى مديرية الجيزة . وبعد ان يعبر السكة الحديد عند شارع البرنسات يسير على الارض حتى يصل الى حدود الصحراء ، شمالى الأهرام، حيث يجب أن تنشأ مدينة الأوقاف فى هذا الموقع الصحى ، بدلا من ازالة المزارع غرب الدقى وانشاء المدينة فى هذا المكان الرطب ونحن احوج ما نكون الى الخضرة فى القاهرة .

الخط الثانى : يبدأ من نهاية العباسية ، فأول شارع فاروق ، فباب الشعرية ، فميدان الملكة فريدة ، فشارع عبد العزيز ، فميدان الأزهار ، فميدان الاسماعيلية ، حيث يلتقى بالخط الأول فيسير واياه حتى كلية الطب ، وينعطف بعدها ليسير على سكة خط حاوان الأرضية الى حلوان. ويلغى من خط حلوان المسافة من السيدة زينب الى باب اللوق بشارع منصور ، حيث تكثر المزلقانات .

والجزء العلوى من هذين الخطين يبلغ نحو ١٦ كيلو مترا طولا .

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* جمعية المهندسين الملكية ــ مجموعة اعمال المؤتمر الهندسى الثانى المنعقد بجامعة فؤاد الاول من ٩ ــ ١٢ ابريل سنة ١٩٤٦ (وقتذاك) .

** مدرس ووكيل معمل ابحاث الخرسانة ــ كلية الهندسة ــ جامعة فؤاد الاول سنة ١٩٤٦ .

وصف المشروع :

ليس لدينا ، مع الأسف الوقت الكافى ، لبحث تفاصيل هذا المشروع الكبير ، والمفروض أن يطرح فى مسابقة هندسية لاختيار أوفق التصميمات. وانا نقتصر هنا على ذكر المواصفات الاساسية .

السكة : مزدوجة ، وتوضع القضبان على مسافة ٥ر١ متر فوق فلنكات خشبية راقدة فى الزلط .

الأعضاء الحاملة والأساسات: الاعضاء الحاملة من الخرسانة المسلحة ، ويجب أن تشكل هذه بحيث تصب على أجزاء فى المصنع ، وتنقل الى حيث تربط مع بعضها فوق الاساسات التى تصب فى مكانها ، مع جعل وصلة تمدد كل نحو ٤٠ مترا ، فيسهل بذلك انشاء الطريق العلوى دون عرقلة كبيرة للمرور ، وتنخفض تكاليف الانشاء ، وتسهل الصيانة بازالة الجزء المعيب واستبداله بغيره .

وفى الشوارع الواسعة يخصص الجزء الواقع تحت السكة العلويةلسير مركبات الترامالأرضية وحدها . واما فى الشوارع الضيقة كشارع شبرا ، فيكتفى بوضع صف واحد من الأعمدة وسط الشارع ، والصفين الآخرين على حافتى الأرصفة .

احتياطات الأمن : توضع القضبان مزدوجة لمنع خروج العربات عن الخطوط ، كما هو فى كبارى السكك الحديدية ، وتجعل حوائط الكمرات الطولية اعلى من السكة بنحو متر ، تأكيدا لمنع العربات من السقوط فوق الطريق العام عند وقوع الحوادث . ويراعى فى المحطات سلامة وسهولة انتقال الركاب بين هذه القطارات وبعضها وبينها وبين خطوط المواصلات الارضية .

تنظيم الحركة : يلزم أن يوكل أمر شبكة مواصلات مدينة القاهرة كلها الى هيئة واحدة ، تشرف عليها وتوحد تعريفتها ، وتمكن الراكب بتذكرة واحدة من الوصول الى أية جهة يريد مع حرية استعمال الخطوط التى يشاء ، اذ فى هذا اختصار لوقت الراكب ، ووفر لماله ولمجهود الكمسارى ووقته ، كما يجب التوسع فى تذاكر الاشتراك العامة والمنطقية والتذاكر الاسبوعية للعمال والموظفين ، والدفاتر المحتوية على أعداد ثابتة من التذاكر ، مع مراعاة هبوط الأجر كلما كبرت المسافة .

* * *

وقد يعترض على هذا المشروع انه سابق لأوانه أو انه كثير التكاليف ، رغم أن المتر الطولى لا يحتاج لأكثر من م٣ خرسانة مصبوب معظمها فى المصنع ، وثمنها لا يتجاوز ٣٥ جنيها ، ولكنى أحب أن أوجه النظر الى أن وقت الجمهور الضائع فى المواصلات يوازى فى سنة أكثر من ثمن المشروع بأكمله . فلو قدرنا متواضعين أن نصف سكان القاهرة البالغ ٨ر١ مليون ينقل مرة واحدة فى اليوم ذهابا وايابا لحصلنا على ٠٠٠ر٢٠٠ر١ مشوار يوميا ، فلو توفر عشر دقائق فى كل مشوار ، فانه يتوفر للجمهور ٠٠٠ر٢٠٠ ساعة يوميا ، ولو قدرنا ثمن الساعة من وقت الفرد فى المتوسط بقرشين ونصف فان الوفر يبلغ يوميا ٥٠٠٠ جنيه ، أى نحو ٢ مليون جنيه سنويا ، بينما تكاليف السكة العلوية كلها (٢٥ + ٥) × ١٦٠٠٠ أى نحو نصف مليون جنيه فقط . واما تكاليف السكة والعربات والمخازن والورش ، فيكفى لها كتقدير مبدئى مبلغ مليون جنيه . وبصرف النظر عن وقت الجمهور ، فانه مشروع مربح من الوجهة الاقتصادية البحتة .

three faculty members and reasonably good education program. In 1983, the number of faculty members reached six, laboratory equipment worth more than 1.5 million dollars were bought and fixed in place, and a revised curriculum was adopted. The miniing engineering curriculum was revised for the second time in 1987. Considerable improvements were made in the final revised curriculum.

The laboratory facilities at the B.S. level are excellent, the libraries are well established, and the raw materials for demonstration are available. The total number of Mining Englineering graduates from KAAU until the end of Fall 1987 reached 64 Mining Engineers.

At present, the department is carrying out some research projects in various mining aspects.

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5. Peersonal contact.

In the laboratories there are stocks of ores and raw materials for standard testing and for research work. There are iron ores, iron ore concentrates, gold ores, chromium ores, marble, granite, limestones, metal sulfides and other Saudi Arabian ores, minerals and rocks. In addition, there are some synthetic samples for demonstration in some experiments.

Table 5: Cost for Machinery and Construction of Laboratory Facilities at the Department of Mining Engineering at KAAU.

Laboratory	Cost in SR	Cost in US$
	1,701,949	479,422
Mineral Processing	1,530,524	431,134
Gravimetric Thermal Analysis	1,498,478	422,107
Rock Mechanics	227,372	117,048
Photoelasticity	227,372	64,048
Ventilation	100,290	28,251
TOTAL	5,4776,109	1,542,848

Libraries:

The King Abdulaziz University has excellent library services. Almost all sorts of scientific and technical books are available for students, researchers and faculty members. The main library in the campus contain books, references, periodicals, dissertations, micro-films, and educational films. In total, there are about 400,000 books and references and about 600,000 other items in the library.

In addition, each College has its own library where the required references and text books are avaiiable. In the Engineering library, there are 20,000 volumes of books and references out of which 4,000 volumes are in Arabic and about 16,000 volumes are mostly in English and the rest are in other languages. Many of the international periodicals in various engineering fields are also available in Engineering library.

Further more, the text book centers (TBC) provide the best educational service for undergraduates in the campus. Each college has its TBC. It guarantees a copy of each book assigned as a text book for each student in all the courses he is registered in. In the College of Engineering, the TBC contains over 62,000 text book volumes (1440 text book) that cover 401 subjects in the various engineering fields. In the mining engineering fields, there are 1569 volumes (40 text books) covering 115 subjects in all the mining engineering topics.

SUMMARY

The mineral resources in the Saudi Arabian Kingdom are abundant. They are mostly located in the virgin area of the Western Region of the Kingdom, the Arabian shield, along the Red Sea Coast. For diversification of the national income, the Saudi Government has though in exploiting their mineral resources while they have the surplus of the oil revenue. To achieve this goal, a continual flow of mining professionals is needed. In 1975/76 the Faculty of Engineering at KAAU in Jeddah was planned to commence including the Mining Engineering Department. This department had a strong start with

TABLE 4: THE ORIGINAL MINING ENGINEERING CORRICULUM AND ITS REVISIONS AND MODIFICATIONS.

1976 / 1983		1983 / 1987		1987 /	
UNIVERSITY REQUIREMENTS: (14 Credit Units)		UNIVERSITY REQUIREMENTS:* (14 Credit Units)		UNIVERSITY REQUIREMENTS: (14 Credit Units)	
Islamic Studies	8	Islamic Studies	8	Islamic Studies	8
Arabic & English Languages	6	Arabic & English Languages	6	Arabic & English Languages	6
COLLEGE REQUIREMENTS: (79 Credit Units)		COLLEGE REQUIREMENTS. (79 Credit Units)		COLLEGE REQUIREMENTS: (57 Credit Units)	
English Language		English Language		English Language	3
Basic Sciences	38	Basic Sciences	38	Basic Sciences	27
Engineering Sciences	33	Engineering Sciences	35	Engineering Sciences	23
Engineering Economics and Management	8	Engineering Economics and Management	6	Engineering Economics and Management	4
DEPARTMENT REQUIREMENTS: (52 Credit Units)		DEPARTMENT REQUIREMENTS' (52 Credit Units)		DEPARTMENT REQUIREMENTS: (94 Credit Units)	
Geology	18	Geology	10	Geology	8
Intr. to Mining Engineering	2	Intr. to Mining Engineering	2	Principles of Mining Engineering	3
Mining Methods	2	Mining Methods	2	Mining Methods	3
Mine Support	2	Rock Mechanics	3	Rock Mechanics I & II	7
Rock Blasting	2	Rock Blasting	2	Rock Blasting	3
Mine Plant Design	4	Mine Plant Design	4	Mine Plant Design I & II	6
Mine Ventilation	3	Mine Ventilation	3	Mine Ventilation and Safety	4
Mine Planning	4	Mine Planning	4	Mine Planning	4
Mineral Processing	4	Mineral Processing	4	Mineral Processing	4
Other Engineering Courses	8	Mineral Economics	3	Mineral Economics	3
Elective	3	Mine Surveying	3	Mine Surveying	4
		Surface Mining	2	Surface Mining	3
		Other Engineering Courses	9	Mine Laws and Management	3
				Principles of Metallurgy	3
				B.S. Project	4
				Other Engineering Courses	16
				Electives (two courses)	6

of the first engineering departments of the College, the Mining Engineering Department went through all these revisions and modifications. Each time the mining engineering program was improved to broaden and enlarge the background of the graduates with additional aspects related to their profession, the Mining Engineering Field. Table 4 presents the main features of the original curriculum (1976/77) in the Mining Engineering Department, as well as its revisions and modifications during the year 1983/84 and 1987/88. Comparing the first revision (1983/84) with the original program, the following improvements were made:

— The total number of credit hours for mining engineering courses were increased by decreasing the time allocated for geology courses.

— Important mining engineering-related courses such as Mine Surveying. Mineral Economics, and Surface Mining were introduced.

In the last revision, (1987/88), further improvement was made on the program, a brief summary of which is as follows:

— the total credit hours were increa- from 145 to 165.

— the departmental share of the total ntmber of credit hours was increased from 52 to 94. This would give the student more depth in his professional field.

— some courses of particular importance to the background of the mining graduates were added such as: Mining Laws and Management, Safety in Mines, Principles of Metallurgy, and Conservation and Mine Environment.

— A number of elective courses were designed to encourage the student to study, in more depth, one of the mining engineering aspects of his choice. Two courses (6 credit hours) are to be chosen by each student.

— For the first time, the B.S. senior project was included in the curriculum as a part of graduation requireements.

Practical Training

One of the basic requirements for all engineering graduates at KAAU is that the student should fulfill two sumer training sessions of two months each. In mining engineering, at beast one of these two training sessions (usually the second session) should be in a field related to mining engineering.

Laboratories:

The department of Mining Engineering at KAAU is well equipped with laboratory facilities for undergraduate level teaching. The laboratory requirements at the undergraduate level are standard and well known. On the other hand, the research equipment is not usually standard., In research, it is always the case that when there is a financed research project, the needed equipment is specially designed and manufactured or bought as standard and it differs from one project to the other. instruments. As the time passes and the number of projects increase, the research laboratories are gradually built up.

The laboratory facilities in the Department of Mining Engineering at KAAU include six well equipped laboratories in various areas of mining engineering education. These laboratories include: mineral exploration, mineral processing, gravimetric thermal analysis, rock mechanics, photoelasticity, and ventilation. The total cost for the machinery and construction of these laboratories is over SR 5,477,000 which is equivalent to US: 1,542,800. (SR. 3.55 = US: 1.00 in 1982). Table 5 shows the paid value for the mining engineering laboratory facilities at KAAU based on the 1982/83 prices.

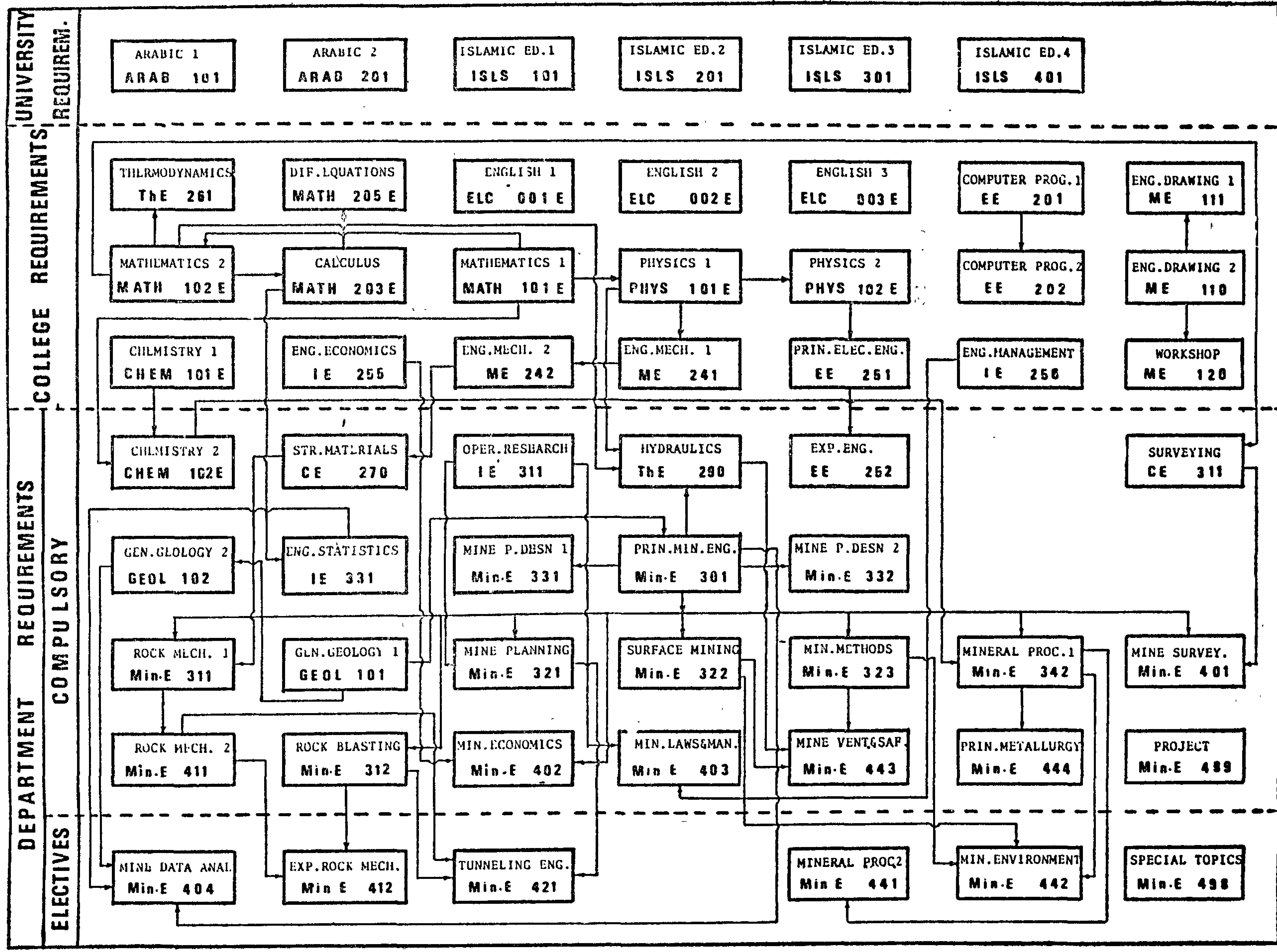


Figure 3: A schematic diagram for the Mining Engineering courses and their pre-requisites.

Table 3: Graduates and Faculty Members (Saudis and Non saudis) from 1976 to 1988.

Year	Graduates			Faculty		
	Saudi	Non-Saudi	Total	Saudi	Non-Saudi	Total
1976/77	—	—	—	1	2	3
1977/78	—	—	—	1	2	3
1978/79	—	—	—	1	3	4
1979/80	—	—	—	1	4	5
1980/81	1	3	4	1	4	5
1981/82	4	3	7	1	5	6
1982/83	1	1	2	1	5	6
1983/84	10	1	11	1	5	6
1984/85	12	8	20	1	5	6
1985/86	7	5	12	1	4	5
1986/87	6	2	8	1	4	5
1987/88				1	4	5

DEVELOPMENT OF THE MINING ENGINEERING CURRICULUM AT KAAU.

...The Education System :

The education system followed at KAAU is similar to that followed in the United States. That is, it is based on the number of credit hours required for graduation for graduation rather than the rigid number of courses per year, semister or quarter in order systems. The followed here allowed the student to carry as many credit hours as he can (maximum and minimum limits) based on his academic achievement, grade point average, GPA, with the guidance of his academic advisor. In this system, the student spends on the average two years (Freshman and Sophomore) covering the University and College requirements. After joining the department of his choice, the student covers the upper level courses in about three more years. Two summer training sessions, two months each, are required by each student before his graduation. As per the last revision of the curriculum, the student has to prepare a B.S. senior project as a partial fulfillment for his B.S. degree.

The mining engineering program at KAAU is structured in such a way that it provides the mining engineering graduate with enough background to perform and control interdisciplinary tasks in developing and exploitation of mineral resources. Emphasis is placed on a balanced integration of engineering and science core courses. The courses interaction is designed such that the students develop the ability to predict engineering problems and be ready to face them, and to analyze complex real situations in mining engineering through the application of general principles. The basic science courses consist of mathematics, physics, and chemistry. The engineering courses include. Electrical, civil, industrial, and thermal engineering. The integration of these background courses together with the main mining courses develops a highly qualified mining engineering graduate. Figure 3 gives the flow chart of the core and departmental courses and how they form an intact educational unit.

Curriculum:

The original curriculum for the Faculty of Engineering, KAAU established in 1976/77, has gone through revisions and modifications. The first revision was done in 1983, and the second will be effective starting spring semester of 1988. As one

field of mining only (1). This includes mine management, mineral processing, organization and control, training, and research and development. In addition, more mining engineers will be required for auxiliary operations such as surveying, ventilation, etc. This estimate seems to be on the high side at present, unless other job opportunities are to be considered.

Table 2- Saudi Job Opportunities for Mining Graduates.

— MINISTRY OF PETROLEUM AND MINERALS

— UNDERGROUND MINES

— OPEN CAST MINES —

— MARINE MINING

— PETROMIN

— MINERAL RESOURCES (MINES & QUARRIES)

— MINERAL PROCESSING OPERATIONS PLANTS

— FEASIBILITY STUDIES FOR MINING PROJECTS —

— GEOPHYSICAL WORK IN MINERALS EXPLORATION

— ARAMCO SABIC & COMPANIES IN

— MINING AND QUARRIES, CEMENT FACTORIES, IRON & STEEL PLANTS, COPPER ZINC AND LEAD PLANTS.

— DIRECTORIES OF SURVEYING (MAPPING)

— ORNAMENTAL STONE PRODUCTION FACTORY

— MOSAIC & MARBLE PLANTS - FERTILIZER PLANTS

— SALT, GLASS CERAMIC FACTORIES

— MINISTRY OF PLANNING (MINERAL RESOURCE PLANNING) —

— MINISTRY OF PUBLIC WORKS AND HOUSING (TUNNELS)

— MINISTRY OF AGRICULTURE WATER (WELL DRILLING)

— MINISTRY OF DEFENCE & AVIATION (ADMINISTRATION OF EN. GG.)

—MINISTRY OF MUNICIPALITIES (TUNNELS IN MAKKAH & MINA)

— MINISTRY OF TRANSPORT (TUNNELS IN ADMIN. OF ROADS)

— AIRPORT PROJECTS

— SALT EXTRACTION & COMMON SALT FACTORIES —

— DIRECTORATE FOR TECHNICAL EDUCATIONAL AND VOCATIONAL TRAINING

MINING ENGINEERING AT KAAU

The enrollment of the students in the Department of Mining Engineering started in Fall semester of 1978/79 and the first mining gradtate got his B.S. In December, 1980. By the end of Spring semester 1986/87, the mining engineering graduates from KAAU were 64 in number. The Saudi graduates comprise 64 percent of the total number of the mining graduates from ûAAU until now.

The number of faculty members at the Department of Mining Engineering at KAAU fluctuated between 3 and 6 at any one time since its start. The Saudi Faculty members ranged from 17 to 33 percent of the total number during this period. At the time being, there is only one Saudi Faculty members (the Chairman of the department), one Saudi graduate came back from the United States with his M.S. Last summer, one more is expected to arrive at any time with his Ph. D., and two more are abroad for their graduate studies. At present, out of a total of five faculty members four are non Saudis. Table 3 shows the graduates and faculty members until 1987.

fall semester of 1978-79. The first graduates from the Mining Engineering department at KAAU graduated in 1980/81. Following the success of the Mining Engineering program at KAAU, the University of Petroleum and Minerals (UPM) at Dhahran (presently King Fahad University of Petroleum and Minerals) decided to initiate their own Mining Engineering program in 1980/81 academic year as a branch associated with the Department of Petroleum Engineering (1). The total number of the mining engineering graduates from these two departments are now about 75, out of which 64 have graduated from the Department f Mining Engineering at KAAU.

As a matter of fact, one should mention that the location of the Mining Engineering Department at Jeddah in the lomiddle of the mineralized area in the Kingdom (the Arabian Shield) is the most appropriate location. The students have the advantage of living in the vicinity of mining and quarrying environments. It is easy for them to visit the mining sites and to attend their training sessions in the active mining areas and to get acquainted with the mining adminstration the active localities. Also they can secure jobs in their professional field, and have a good feeling about what mining societies look like.

JOB OPPORTUNITIES FOR MINING ENGINEERS IN SAUDI ARABIA.

The mining engineering educational background all over the world is of wide spectrum. That is, the graduate studies the basics of many of the engineering disciplines with emphasis on topics related to mining and mineral technology. This is because the mining engineer being at remote places such as mines, has to supervise amost all the engineering professionals and has to participate in solving the problems facing them. Moreover, the marginal profit in small mining operations, as it is usually the case' may require a multi-discipline graduate for economic considerations.

The general technical background of a mining engineering graduate includes : mechanical engineering, machine drawing and workshop, hydraulics, strength of materials, electrical engineering. civil engineering, principles of metallurgy, and sureveying. This makes it possible for the mining graduates, with some training to be able, in a country such as the kingdom, to assist in any of these disciplines. Further more, with his mining and mineral engineering background, the mining engineer is eligible to carry out; evaluation of mineral resources, planning and development of mines, tunneling and underground constructions, rock fragmentation and excavation, mine surveying, ventillation and refrigeration, transportation, and preparation and processing of ores for direct usage or for further extraction processes.

As a matter of fact, the diversity of jobs available to the mining engineers in Saudi Arabia ensures a bright future for them that they will be in demand for at least several decades. (1). Realizing the diversity of background, of the mining engineers. The Civil Service Beareau (CSB) in the Kingdom announced recently a list of available job opportunities for mining engineers in the Universities (research and education), private sector, machine design and sales management, quarries for cement raw materials and industrial minerals, ministry of electricity, banks, Water and Sewerage Directorate, etc.

For a small metalliferous mining operation (400-2000 tons per day), with the assumption that one new mine will be opened per year, it was estimated that the need for Mining Engineers in the Kin gdom within the present 5-years plan (the 4th development plan) will range between 10 to 15 graduates per year in the

Table 1- Economic Feasibility and Mine Development Program (1)

Mine or Deposit	Metal or Mineral	Production t/d	Development or otherwise	Production Year *
Mahd-adh-Dhhab	Au,Ag,Cu,Zn	400	Upto 1986	1987
Al-Masane	Cu, Zn, Ag, Au	2,000	Upto 1987	1988
Jabal Sayid	Cu, Zn. Ag, Au	2,000	Upto 1987	1988
Atlantis-II-Deep	Zn,Cu,Ag,Au,Co	70,000	Upto 1989	1990
Wadi Sawawin	Fe	10,000	Feasibility studies	10 years time
Mugrah Al-Safra	Cu,Pb ,Zn, Ag.Au	2,000	Feasibility studies	-
Wadi Qatan	Ni	2,000	Feasibility studies	-
Az-Zabirah	Al	-	Feasibility studies	-
Baid Al-Jimalah	W	-	Feasibility studies	-
Bir-Tawila	Sn,W.	-	Feasibility studies	-
Sirhan-Turayf	P	-	Feasibility studies	-
Ornamental stone	Limestone, granite	Various	Pilot Plants	-

* The production year stated in this Table has been formally delayed for one or two years.

MINING ENGINEERING EDUCATION IN SAUDI ARABIA

As has been mentioned above. the mining engineering activities in the Kingdom are increasing at a very high rate. Exploration, feasibility studies, development and mining, manufacturing, and marketing of minerals and concentrates have been given priority in the present 4th 5- years plan (3). For the implemenmtation of these goals in the future by Saudi manpower, a continuous supply of national mining engineering professionals mining engineering professionals will be required.

Realizing the need of the country from the high-caliber professionals and experts in this field of Engineering and Applied science at King Abdulaziz University (KAAU) at Jeddah decided to open the Mining Engineering Program as one of the first academic programs in the College in 1975/1976(4). The upper level courses (departmental courses) were decided to be offered starting with the third year of the educational program (Junior level) in the

INDUSTRIAL MINERALS AND COAL

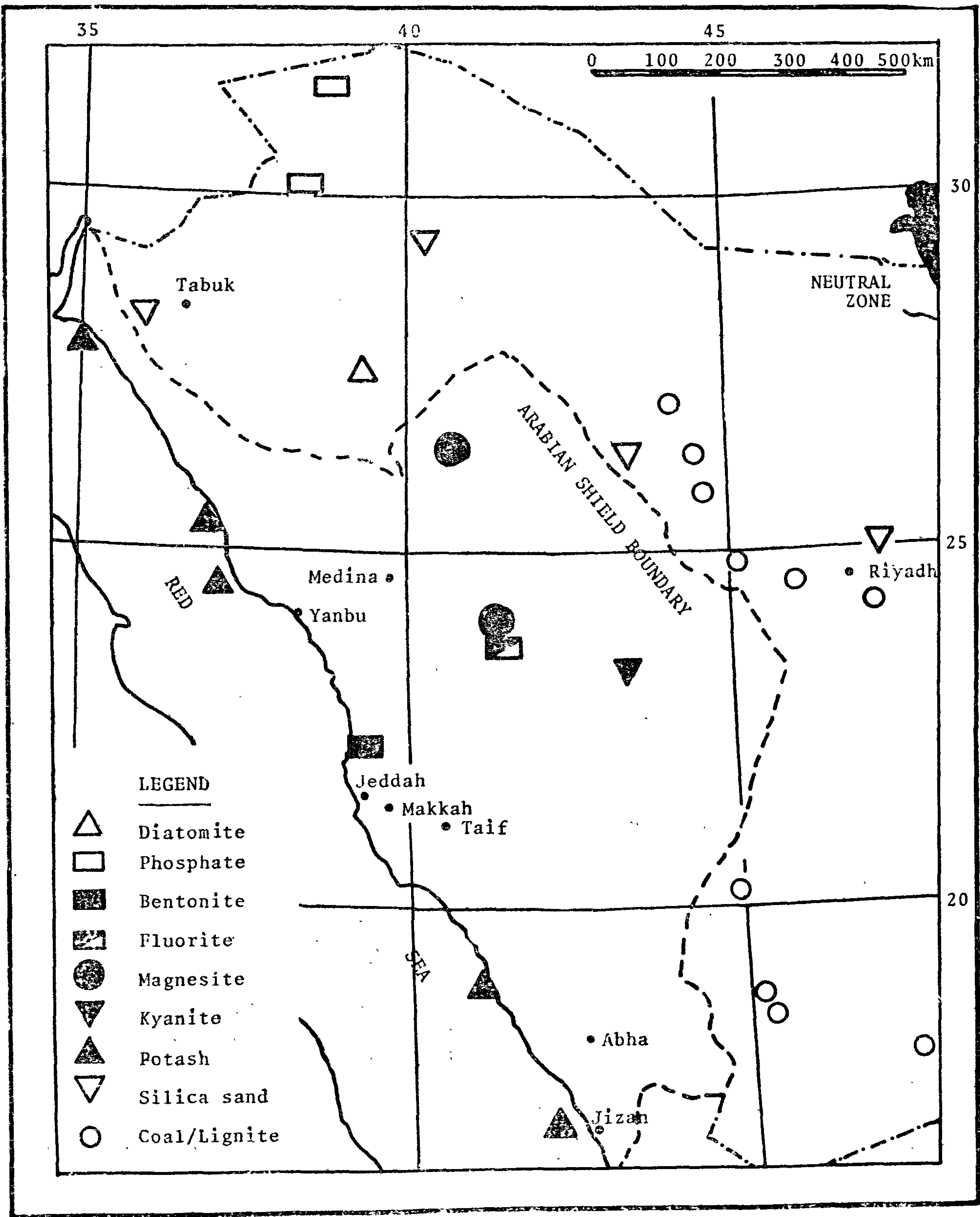


Figure 2: Industrial minerals and coal in the Kingdom of Saudi Arabia

METALLIC MINERALS

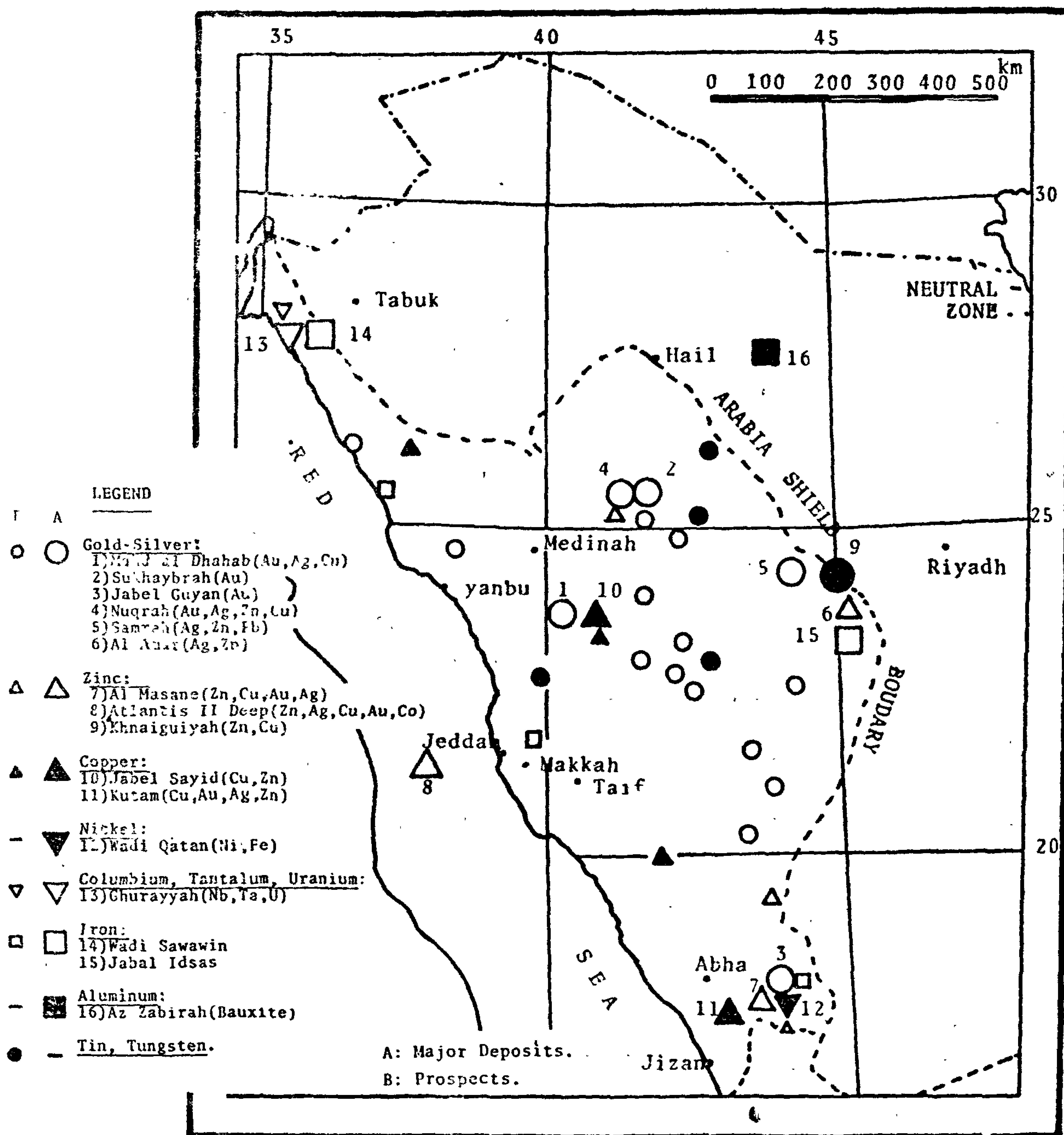


Figure 1 : Metalic minerals in the Kingdom of Saudi Arabia

MINING ENGINEERING EDUCATION AT KAAU

A. — Z.M. Abouzeid* and M.A. Darwish*

ABSTRACT

This paper summarizes the historical background of the foundation and the present status of the Mining Engineering Department at King Abdulaziz Universsity in Saudi Arabia. It lays out the mining industry propsects and the increased need for mining engineering education in the Kingdom of Saudi Arabia. Detailed information on the facilities available in the Department for imparting high level of technical education in this field is being discussed, and possibilities of various job opportunities for the mining graduates have been analyzed.

INTRODUCTION:

The Kingdom of Saudi Arabia has been gifted with vast resources of minerals. Besides petroleum and natural gas, the Kingdom has a large variety of solid mineral deposits potential, both on-land and off-shore. The off-shore mineralization is particularly located in the Red Sea in the form of brines. The surface mineral deposits are located mainly in the Arabian Shield (along the East Coast of the Red Sea). The mineralized areas in the shield extend for distances ranging from 50 to 700 km inland, and runs from the border of the North Yemen in the south to that of Jordan in the North. The Arabian Shield can be considered as a huge reservoir for a wide variety of metalliferous (more than 292 localities) and industrial minerals (more than 347 localities) deposits in varied geologic environments (1,2) (see Figures 1 and 2).

Following the onset of the oil boom in 1973, the Kingdom decided to grant further incentives and encouragement for mineral development in order to continue the flow of national wealth after oil production begins to decline. That is, realizing the future importance of their mineral resources, the Saudi Government decided to invest a part of their oil revenue, from the surplus of income, for the exploitation of their vast mineral reserves. This trend has provided the kindom with an opportunity to diversify its national income, in addition to the agricultural activities, instead of relying totaly on its oil wealth.

Presently, the Kingdom is at the threshold of sarting full scale mining operations for several essential minerals such as : gold, iron, phosphate, copper, etc. Table 1 shows that four mining projects will go into the production stage within three years (included in the 4th 5- years plan 1985-1990) (2). There are several others whose feasibility studies are underway. Further more, the mining activities for cement raw material (limestone, clays, gypsum, iron minerals) have been going on since the 1950's, and it is now at the stage of producing more than 10 million tons of cement. Also quarrying of ornamental stones is covering 10-30 percent of the consumption of the Kingdom from these building materials.

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Tale 3

Experimental results of flash point

Percent of low flash component in blend	flash point of blend, °F			
	A+B	A+ C	B+D	C+D
10%	147.2	149.9	142.7	160.7
20%	130.7	131.9	128.3	155.3
30%	117.9	113.0	117.5	127.4
40%	104.9	108.5	110.3	119.3
50%	97.7	104.0	106.7	116.6
60%	94.1	99.5	104.0	112.1
70%	89.5	95.0	103.1	108.5
80%	86.0	90.5	101.3	103.1
90%	86.8	87.8	103.1	101.3

Table 4

Calculated results of flash point

percent of low flash component in blend	flash poin of blend, °F			
	A + B	A+C	B+D	C+D
10%	150.15	152.82	145.54	163.51
20%	134.29	134.21	131.73	158.23
30%	119.58	110.55	120.21	130.62
40%	106.95	112.71	113.98	121.67
50%	102.59	107.25.	108.72	118.21
60%	97.06	101.92	107.87	115.25
70%	93.04	97.75	106.95	102.92
80%	90.21	93.12	103.40	106.52
90%	88.04	89.20	105.21	103.47

Table 5

Comparison between Calculated and Experimental Flash point of blend (A+B)

percent of low flash component in blend	flash point of blend, °F			
	Experiment	Calculated		
		Nelson' method	Wickey' method	new method
10%	147.2	153.95	152.13	150.15
20%	130.7	138.09	136.02	134.29
30%	117,9	122.31	121.20	119.58
40%	104.9	115.18	111..49	106.95
50%	97.7	108.53	104.67	102.59
60%	94.1	104.90	98.73	97.06
70%	89.5	98.30	95.41	93.04
80%	86.0	93.16	91.21	90.21
90%	86.8	90.13	89.35	88.04

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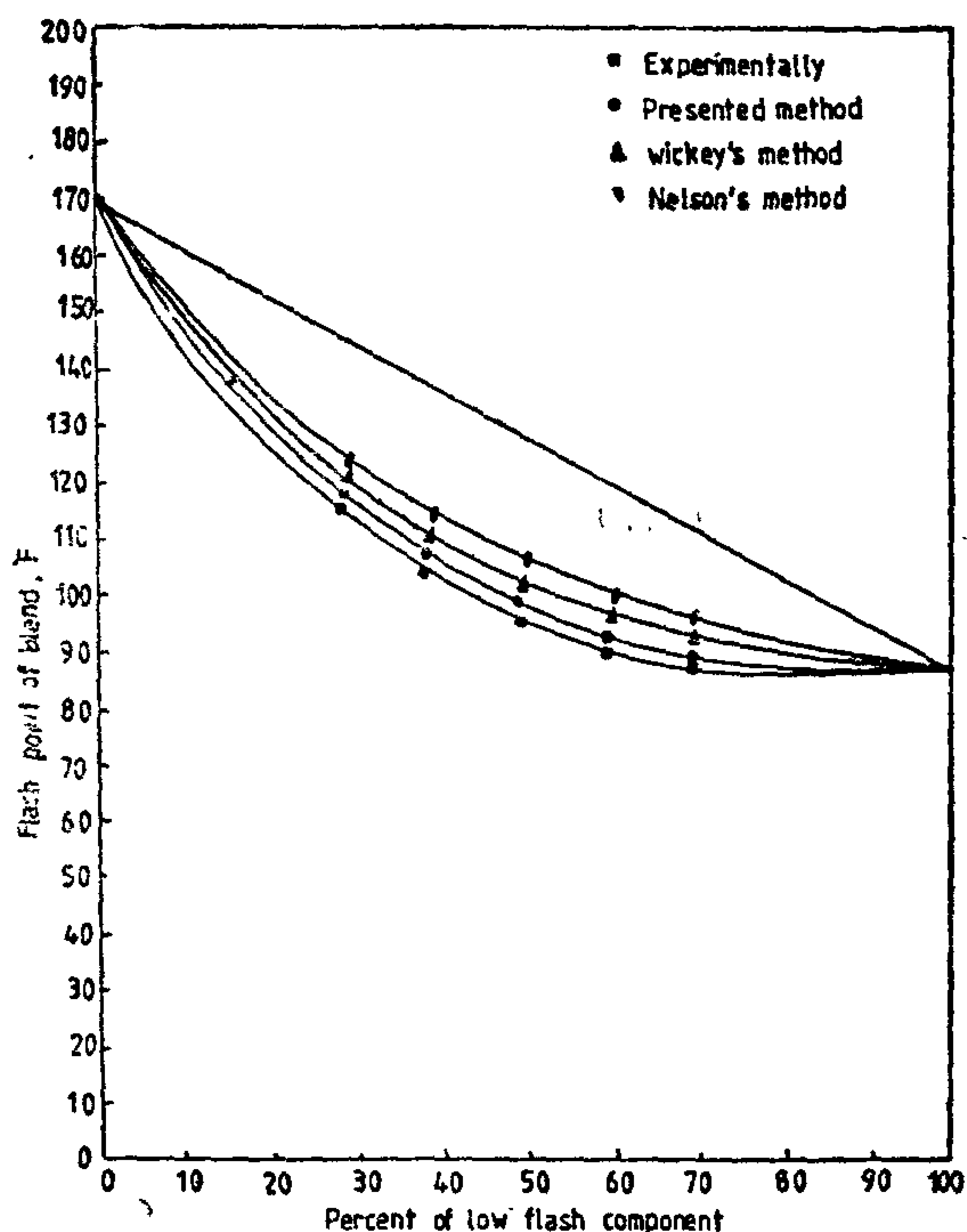
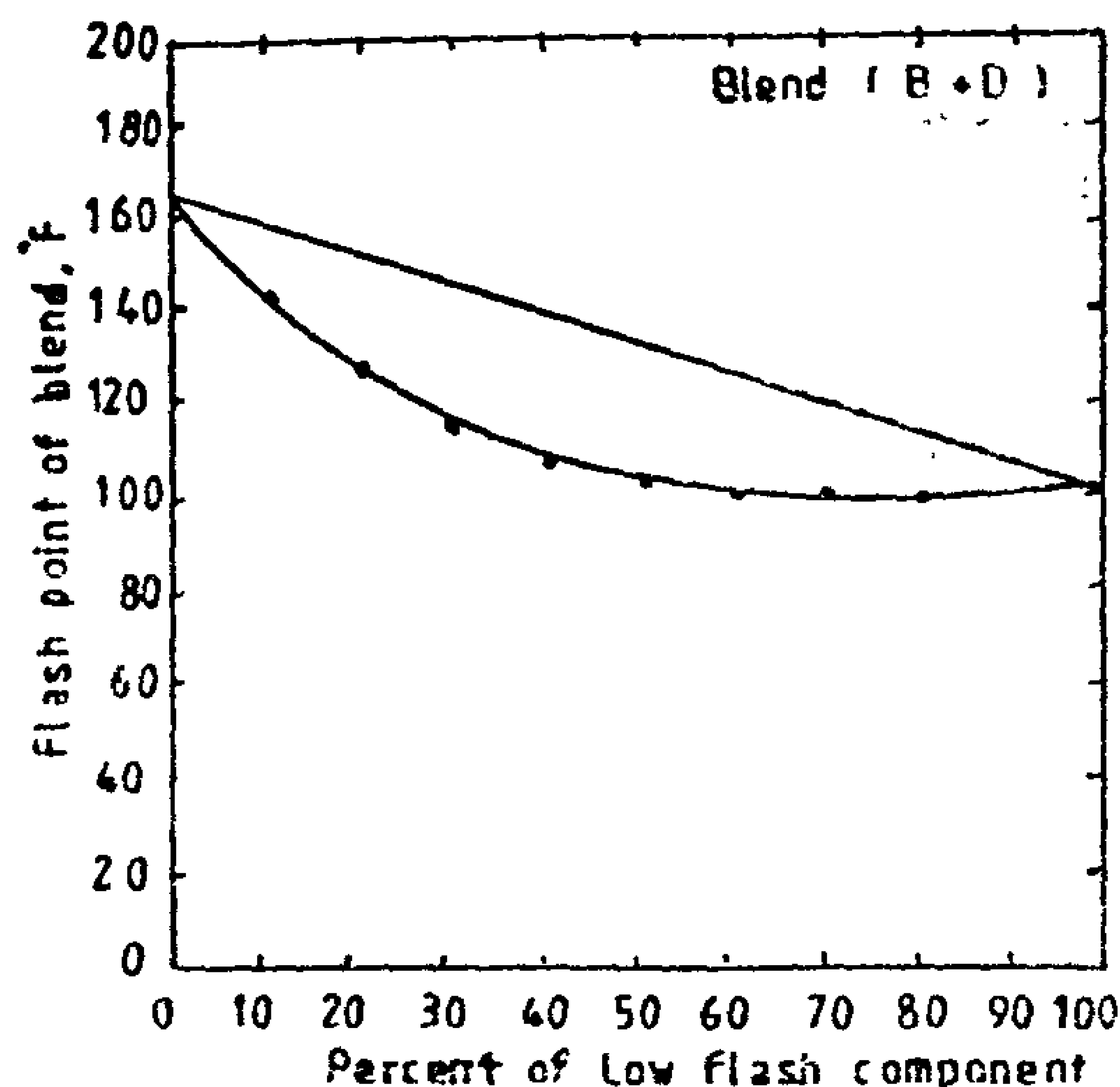
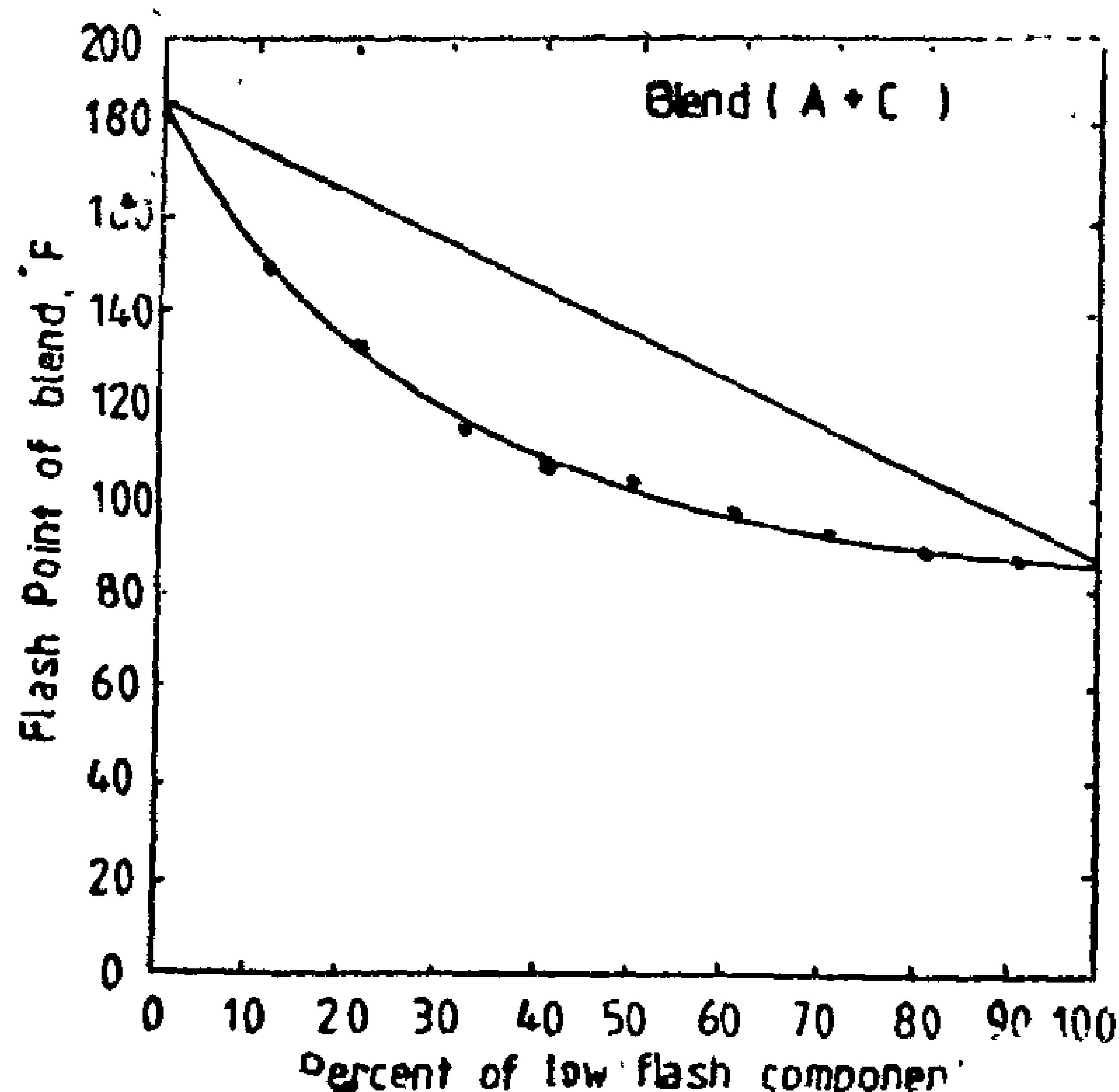


Fig.2 Effect of low flash component on flash point of blend (A+B)





The results obtained according to the new equation were compared to the different calculating methods. The comparative study shows that the results obtained by the new equation gives much more accurate results.

Table 1
ASTM distillation of Stooks

distillat. vol.%	gas oil	kerosene
IBP °C	129	178
10	150	224
20	156	241
30	163	251
40	167	267
50	173	275
60	178	287
70	184	299
80	192	310
90	205	330
FBP	221	362

Table 2
Flash point of stocks

	Stock	°C	°F
A	kerosene	31	87.8
B	Gas Oil	76	168.8
C	Gas Oil fraction (10-50%)	84.9	184.9
D	Kerosene Fraction (20-80%)	40.5	104.9

Discussion of results

Table 3 and figure 1 illustrate that the observed flash points when plotted againest the volume percent of light-flash component in the blend gave a curve below the linear blending line (figure 1) This is justify for all blends in this research work.

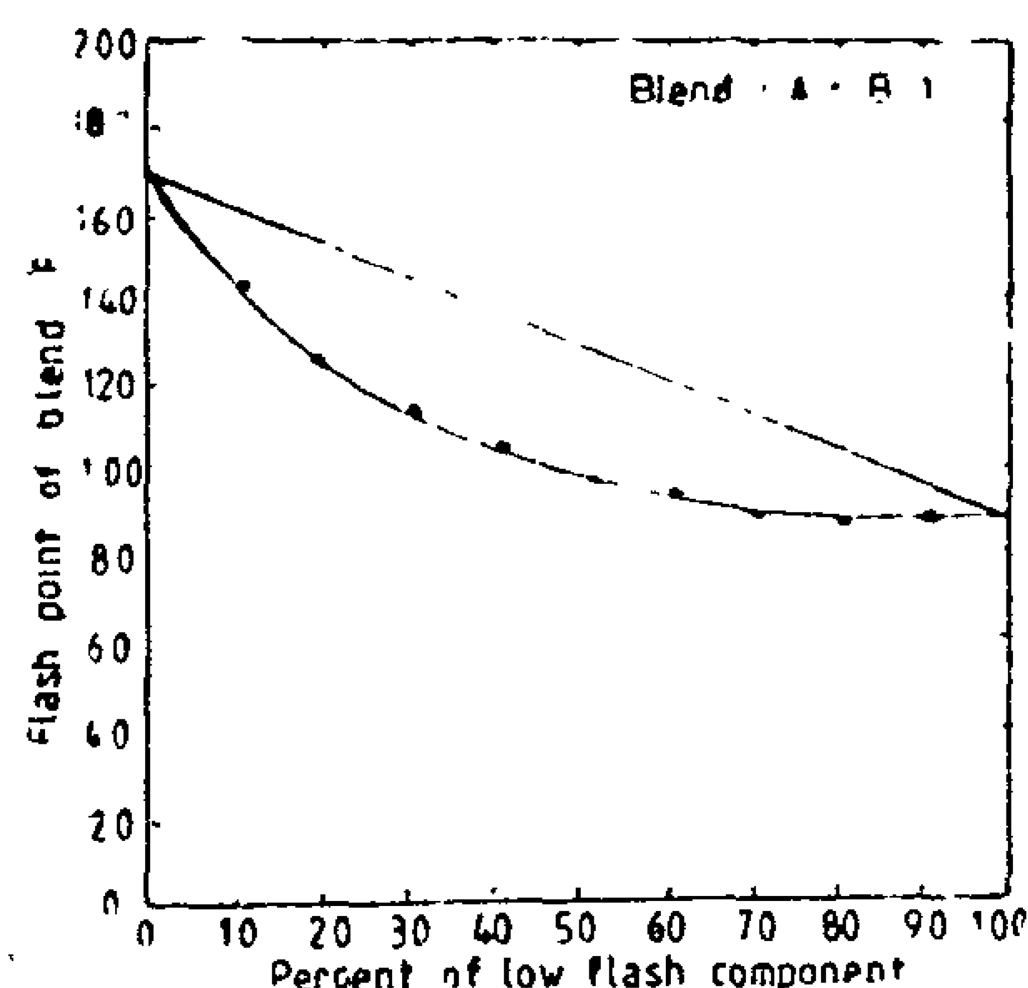


Fig 1: Effect of low flash component on flash point of blend

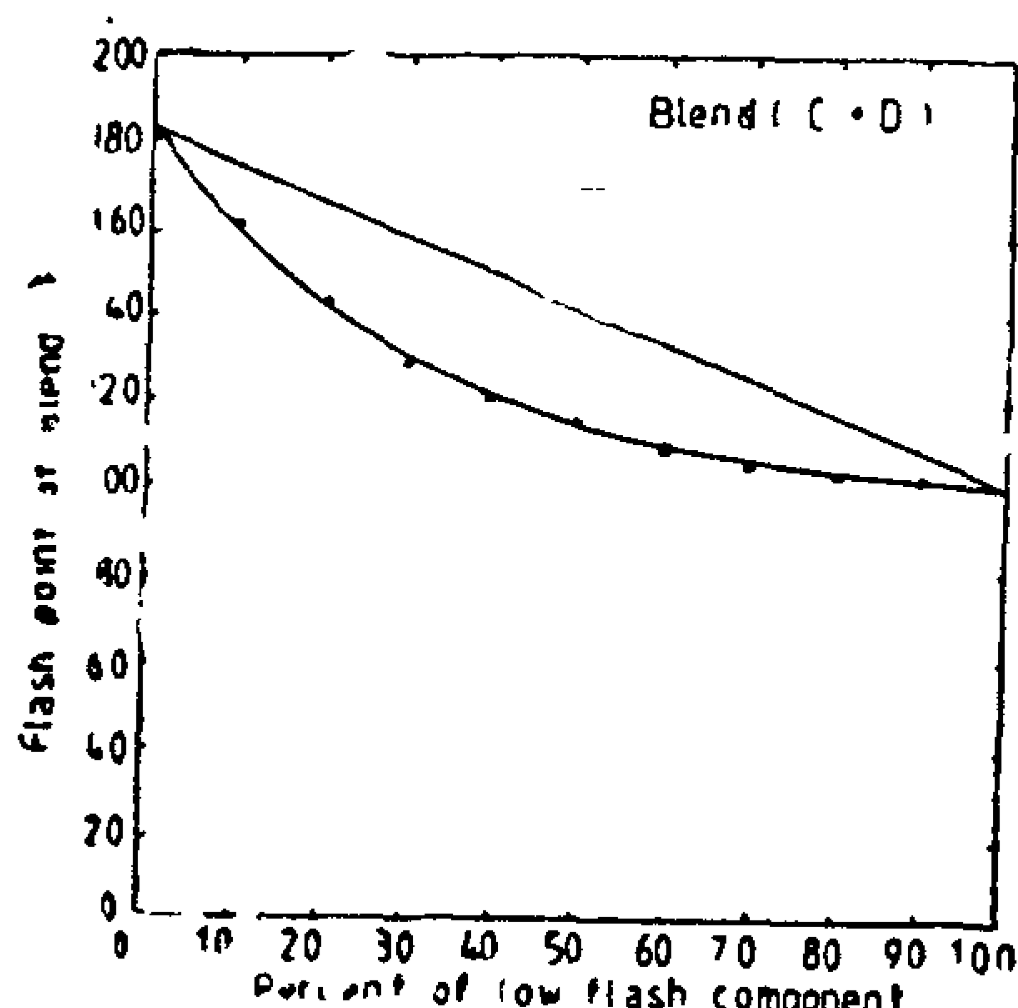


Fig ... of low flash component on flash point of blend

According to this observation, the following equation was proposed for calculation of flash point of blend:

$$F = F_1 X_1 + F_2 X_2 - \alpha F_2 X_2 / X_1 (1 + X_1) \quad (1)$$

where:

α = T1/T2
F = flash point of the blend,°F
F1 = flash point of lighter stock,°F
F2 = flash point of heavier stock,°F
X1 = volume percent of lighter stock
X2 = volume percent of heavier stock
T1 = initial boiling point of lighter stock,°R
T2 = initial boiling point of heavier stock,°R

The first two terms in the above equation give linear relationship and the third term gives the deviation from linear relationship.

According to equation (1) the flash points of blend of the fractions are calculated and illustrated in table (4).

When petroleum products are blended together, it is clear from figure (1) that the flash point of the blend is greater, than that calculated by the volumetric average of the flash point of the blend components. From figure (1) also, it is clear that, by increasing the percentage of the low-flash component, the flash point of the blend decreases rapidly up to 50% and then slowly. So, we can declare that the percentage of the low flash component and its initial boiling point have a great effect on the flash point of blend. Also, the difference in flash point between the two stocks has some effect on the flash point of the blend. In the same time, by increasing the difference in flash point of the two stocks, the blending curve become more and more steep while the distance between the blending curve and linear blending line is nearly fixed for all blends.

The variation of the present method and the other described methods is given in table (5) and illustrated in figure (2).

From this table and that figure it is noted that Nelson's method is far from the blending curve of the flash point, and Wickey's method is some how better, while the new method presented in this work is relatively more accurate.

Conclusion

The flash point procedure using an average of flash point of the stocks in proportion to the fractions of each in the blend gives a flash point of blend higher thanthat obtained experimentally.

A new equation is deduced empirically to calculate the flash point of the blend of petroleum fractions. This equation illustrates a good approach to the results obtained experimentally. This equation comprises three items. The first two items give linear relationship and the third item gives the deviation from linear relationship.

A NEW METHOD FOR CALCULATING FLASH POINT OF BLENDS

Salah M.M. Elsayed* and Galal M. Abdel-Alim*

Abstract

This paper presents new method for calculating flash point of blends. This methods takes into consideration the relative volatility of the two stocks, and the percentage of each in the blend. An expression has been derived empirically to calculate flash point of the blend.

Introduction

Flash point is an important specification for petroleum products which generally are blends of many stocks. The flash point is further indication of the range and nature of the boiling point curve. It designate the temperature at which the vapor above an oil will momentarily flash in the presence of a flame and the temperature at which vapors are evolved rapidly enough to burn continuously. This test serves to indicate the temperature below which an oil can be handled without danger of fire.

In making blending, flash point is not an additive property because it is not a linear function of the flash point of the blending agents (1).

Several methods were used to estimaté the flash point of blends of petroleum products. One of these calculating methods is described by Nelson (2). This method is based on 0-10% point of ASTM distillation of the stock and the difference in flash point of the two stocks. The approximate relationship between flash point and O to 10% boiling range for distilled fraction is :

$$F = 0.64\ T - 100$$

where :

F = flash point, °F

T = boiling range, °F

Another method is suggested by Wickey (3). This method deals with the flash point indexes of the stocks in the blend. The flash point index is a fonction of flash point, which may be obtained from the following equation :

$$\text{Log}_{10} I = -6.1188 + 4345.2/(T+383)$$

where :

I = the flash point blending index

T = the flash point of a stock or blend, °F

A new method for calculating the flash point of blend is presented in this research work and is based on the initial boiling point of the two stocks and the volume percent of each component in the blend.

Flash point apparatus and procedure

The common flash point apparatus are the open cup, ASTM-D92, Pensky-Martens, ASTM-D93 for heavy stocks, and the Tag closed tester, ASTM-D56 for the light stocks (4).

The closed apparatus is the more exact for the determination of the flash point, but the open cup is used extensirely because of its simplicity (5). The Tag closed tester was used for carrying out of this research work.

The designation of this apparatus and the procedure are illustrated in the Annual Book of ASTM Standards (4).

The blends were obtained from kerosene and gas oil and their fractions. The specification of these stocks are presnted in table 1 and 2.

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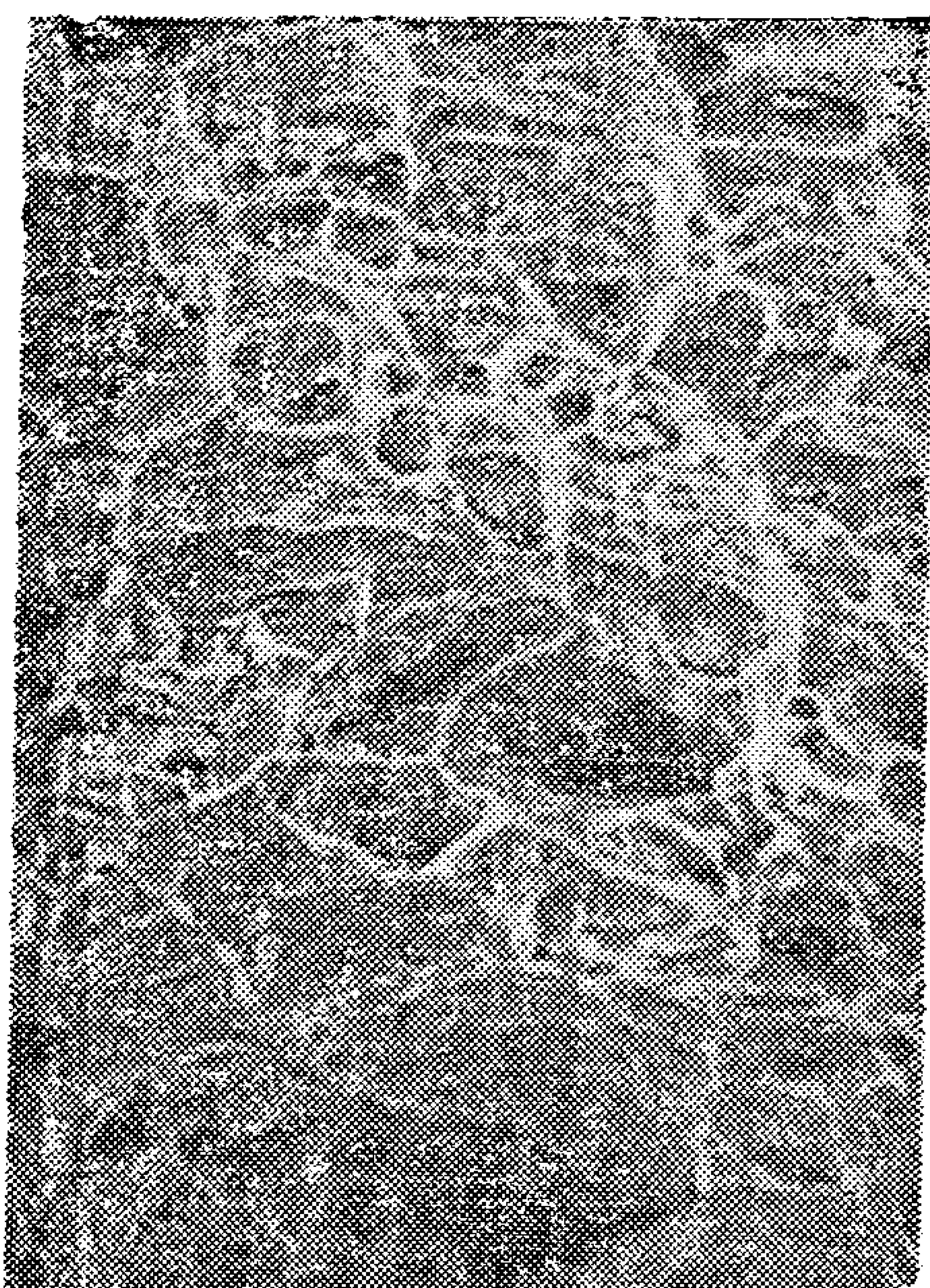


Fig. (6) : Fracture surface 1000X.

Figure (8) gives the main chemical elements of the nonmetallic inclusions. The nonmetallic inclusions contain Si, Mn and Fe oxides and sulphides.

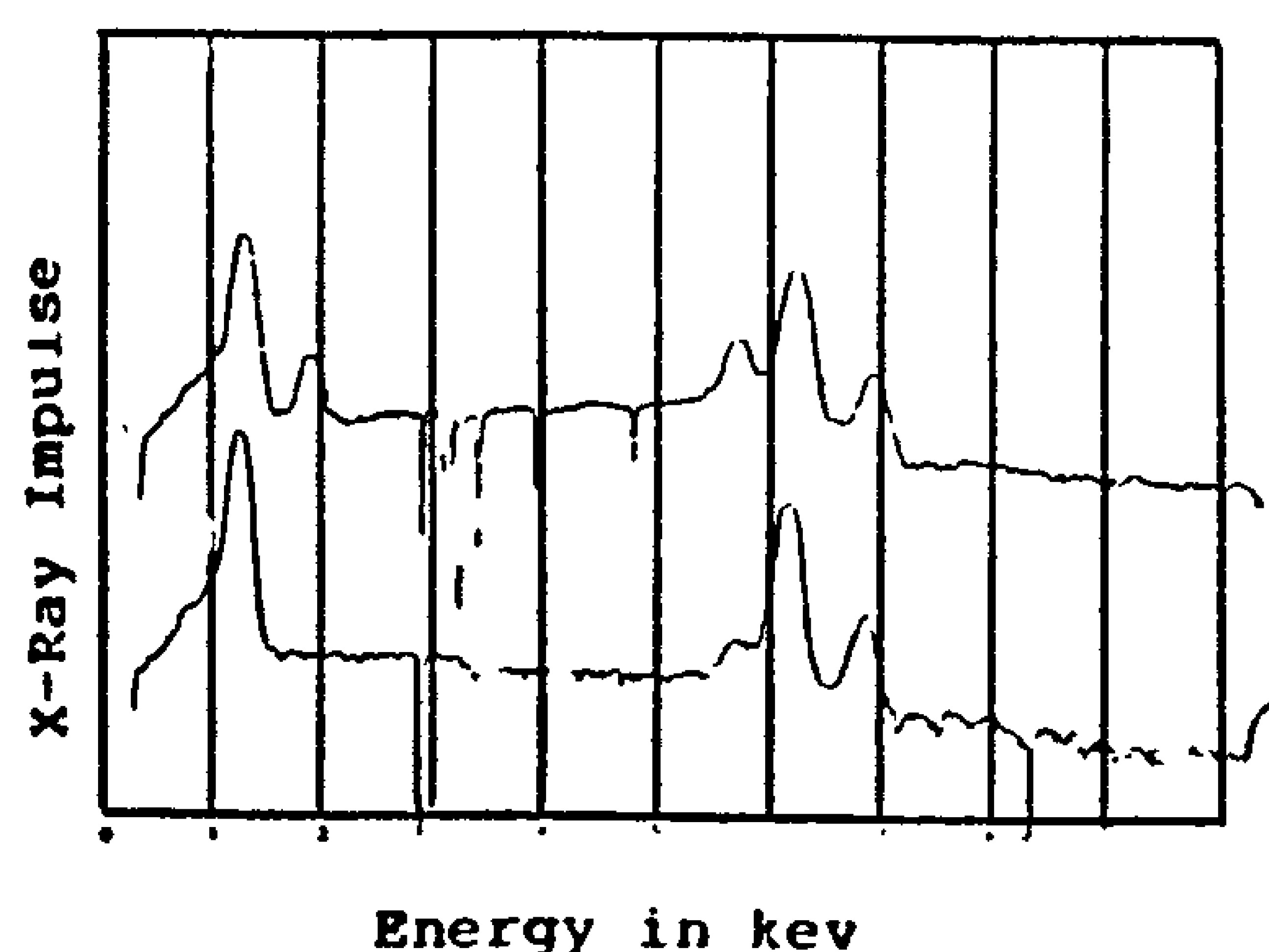


Fig. (7) : Chemical analysis.

4. CONCLUSION

(1) Edge cracking of the investigated specimens may be attributed to the existence of some blowholes which are locaed very close to the surface of slabs after continuous casting. These blowholes were opened during heating or rolling and then oxidized. Oxidized blowholes cannot be welded during rolling and cause cracks.

(2) Oxidized blowholes are distorted is shape during rolling giving rise to very long oxide films penetrating deep by inside the metal.

Very large grains with many rounded nonmetallic inclusions are encountered around the oxide films caused by the oxidized blowholes.

(4) The microstructure between oxide layers is very nonuniform and highly decarburized.

(5) Oxide films were observed in the transverse direction and far from edge cracking, the fact which indicates that oxidized blowholes may project tongues of oxide films in all direction to far distance from the cracked edges.

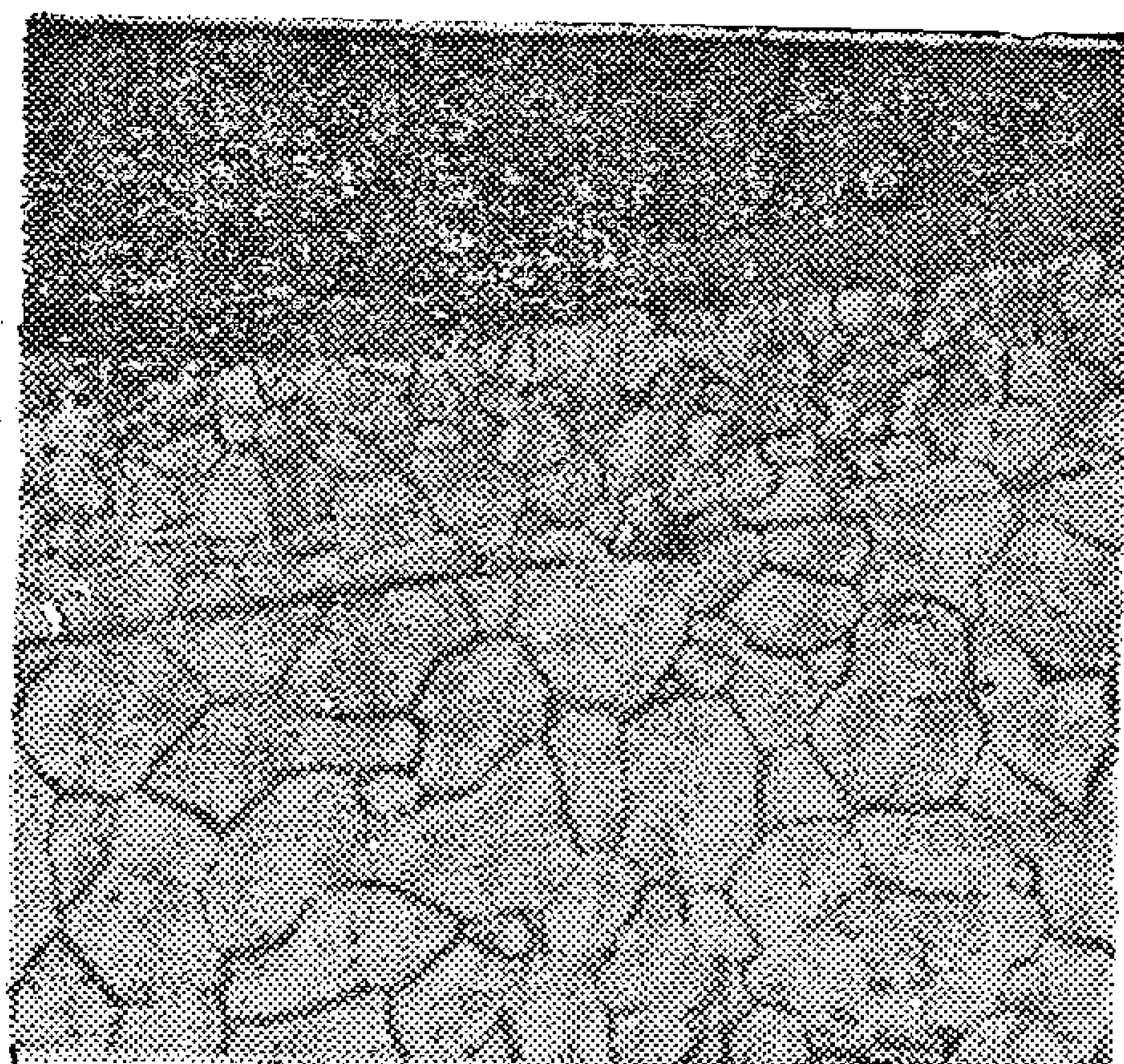
(6) Care should be exercised to prevent the occurrence of subsurface blowholes which are located so near to the surface that they can be opened and oxidized during heating or rolling.

5. REFERENCES

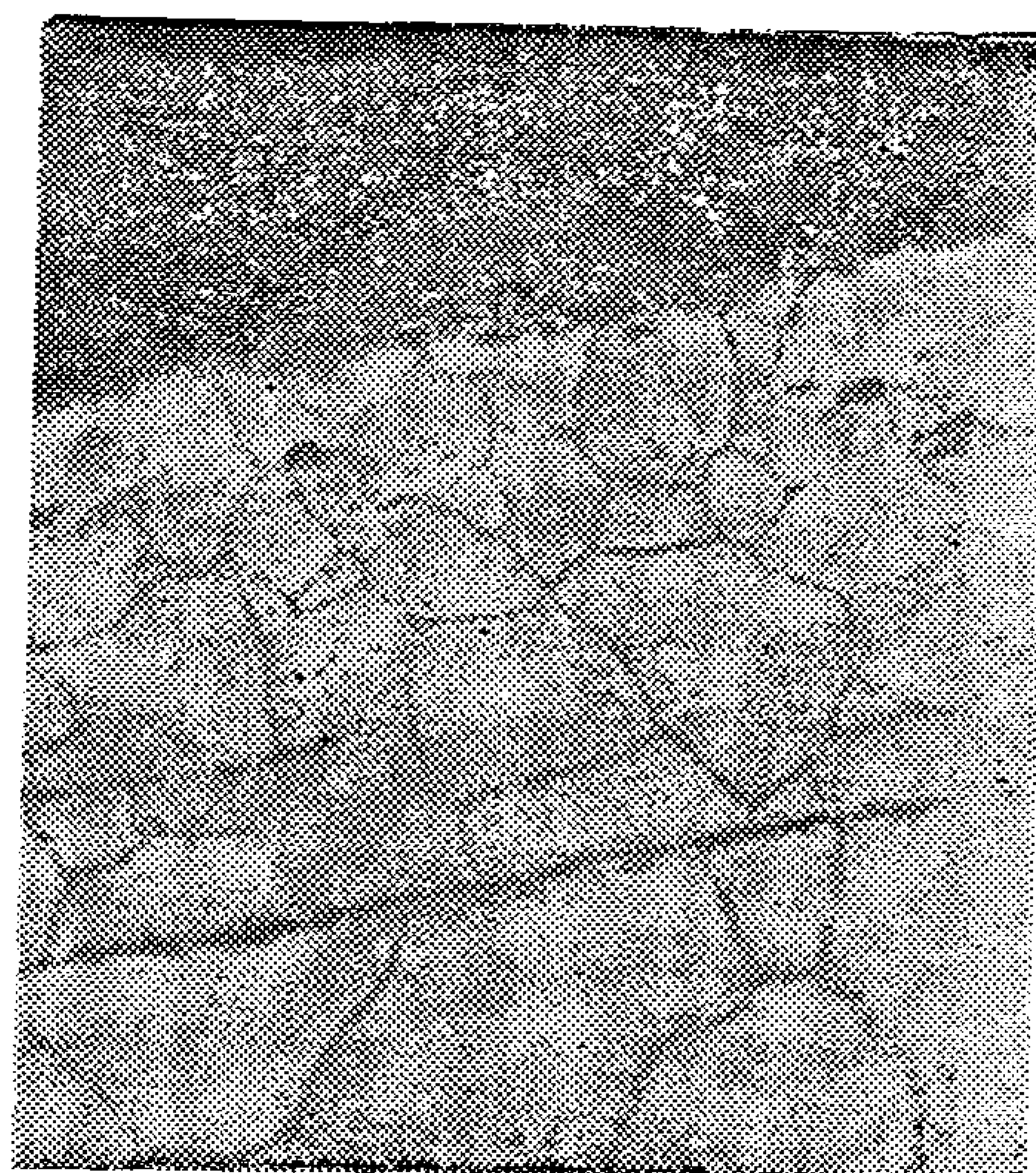
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a

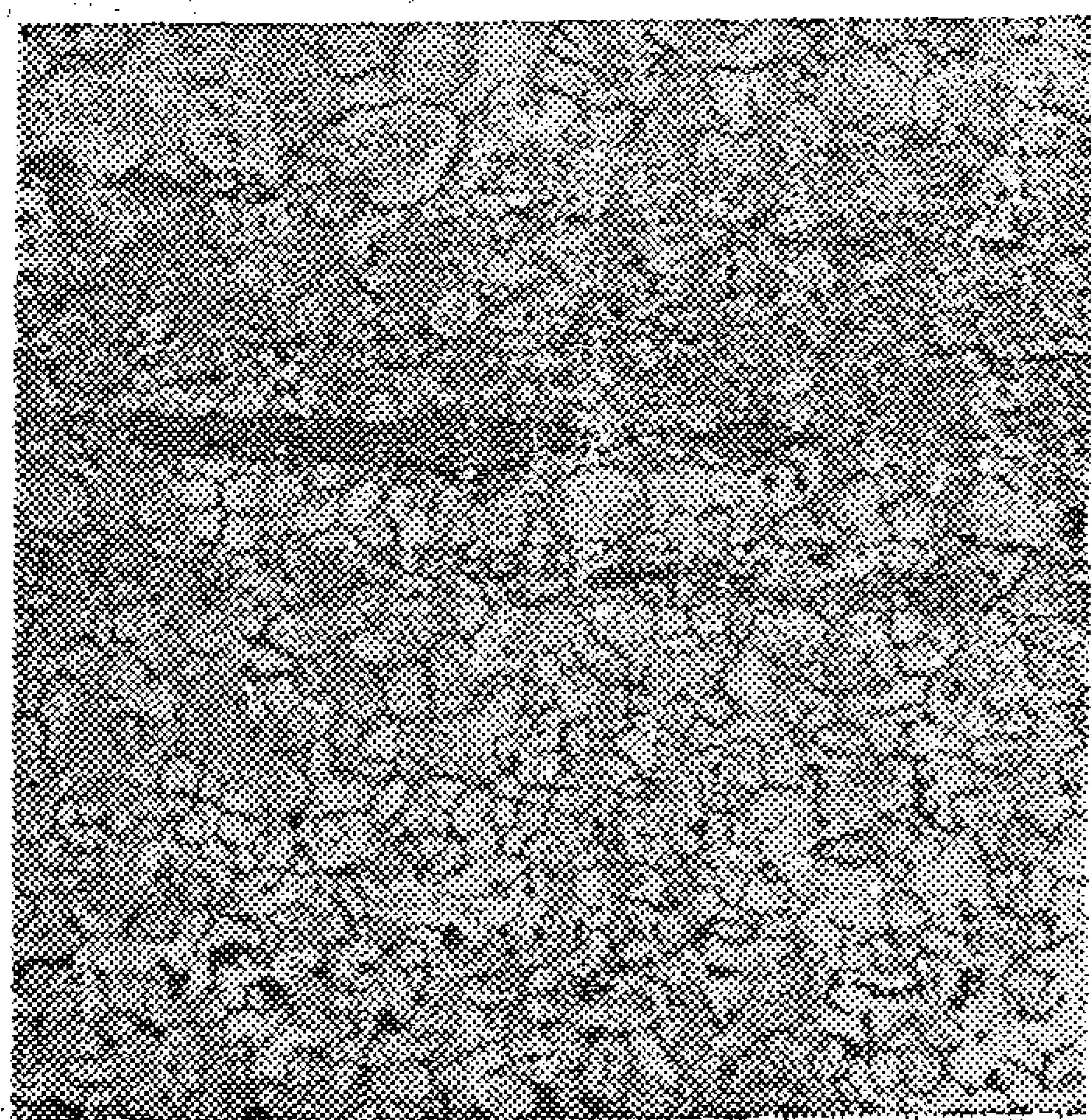


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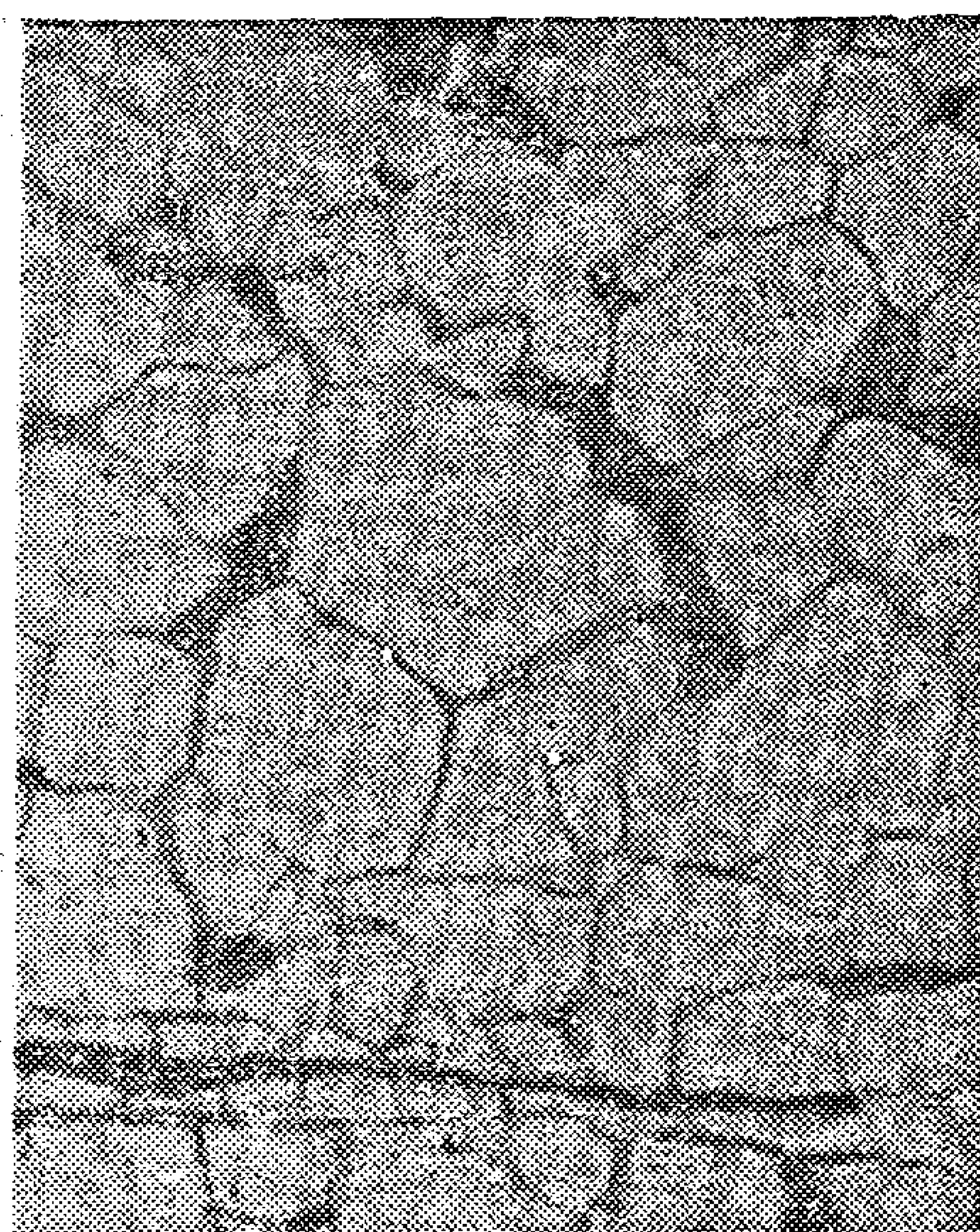
Fig. (4) : Specimen No. 3. a 400X; b 1000X.



a



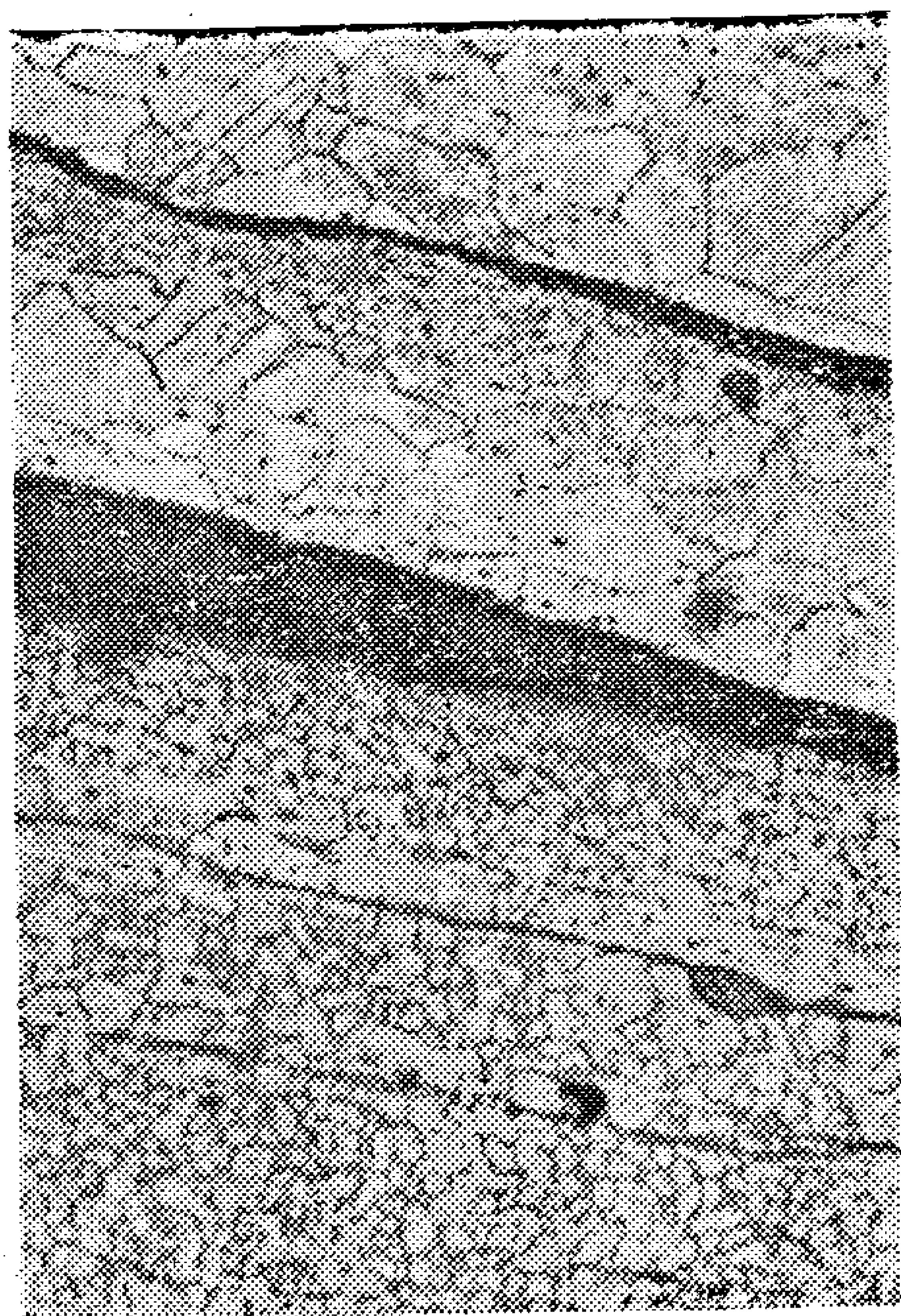
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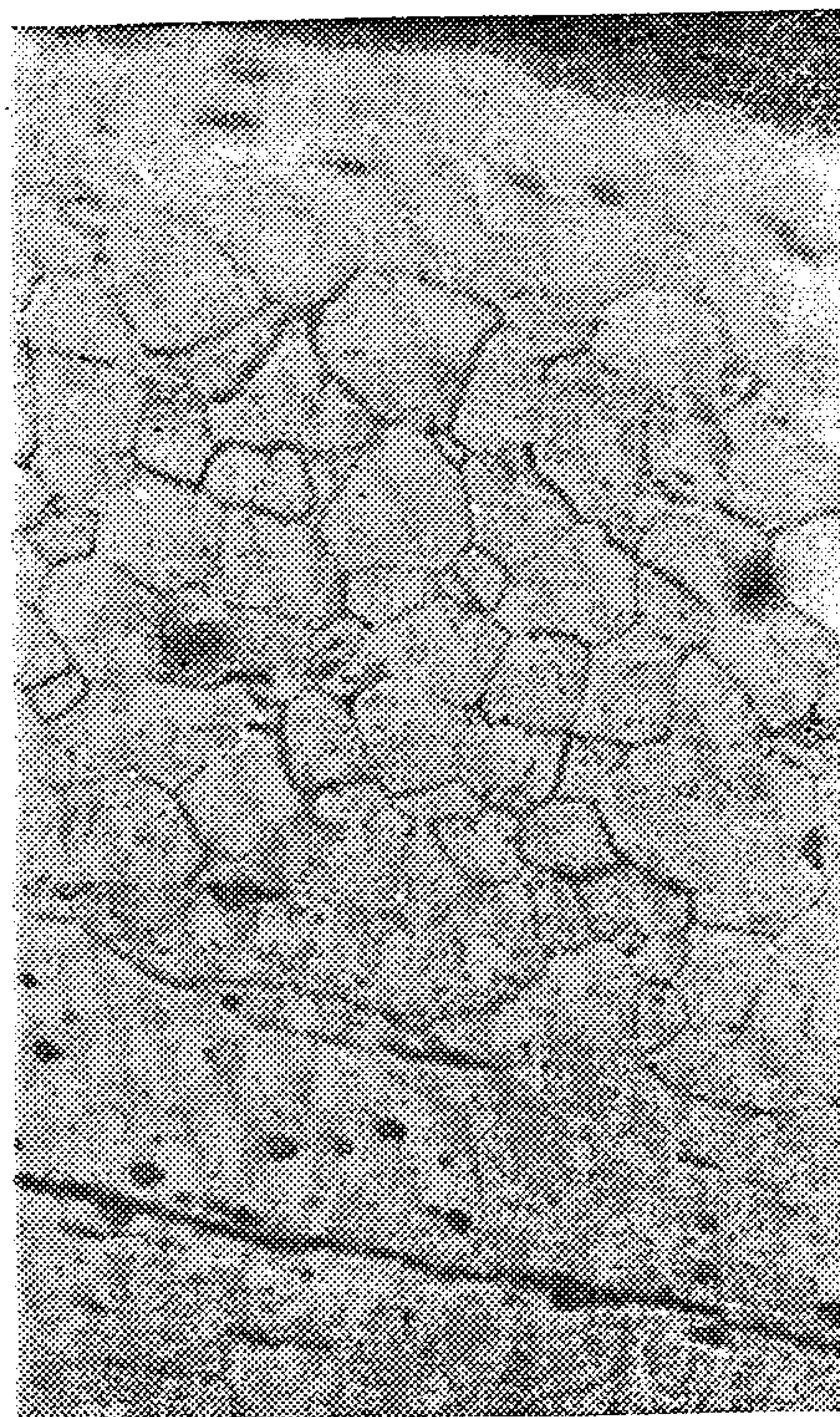
e

Fig. (5) . Specimen No. 4. a and b 100X; c 1000X.

The fractograph which was performed using an electron scanning microscope (Fig. 6) shows that the fracture surface consists of dimples with some coarse nonmetallic inclusions.

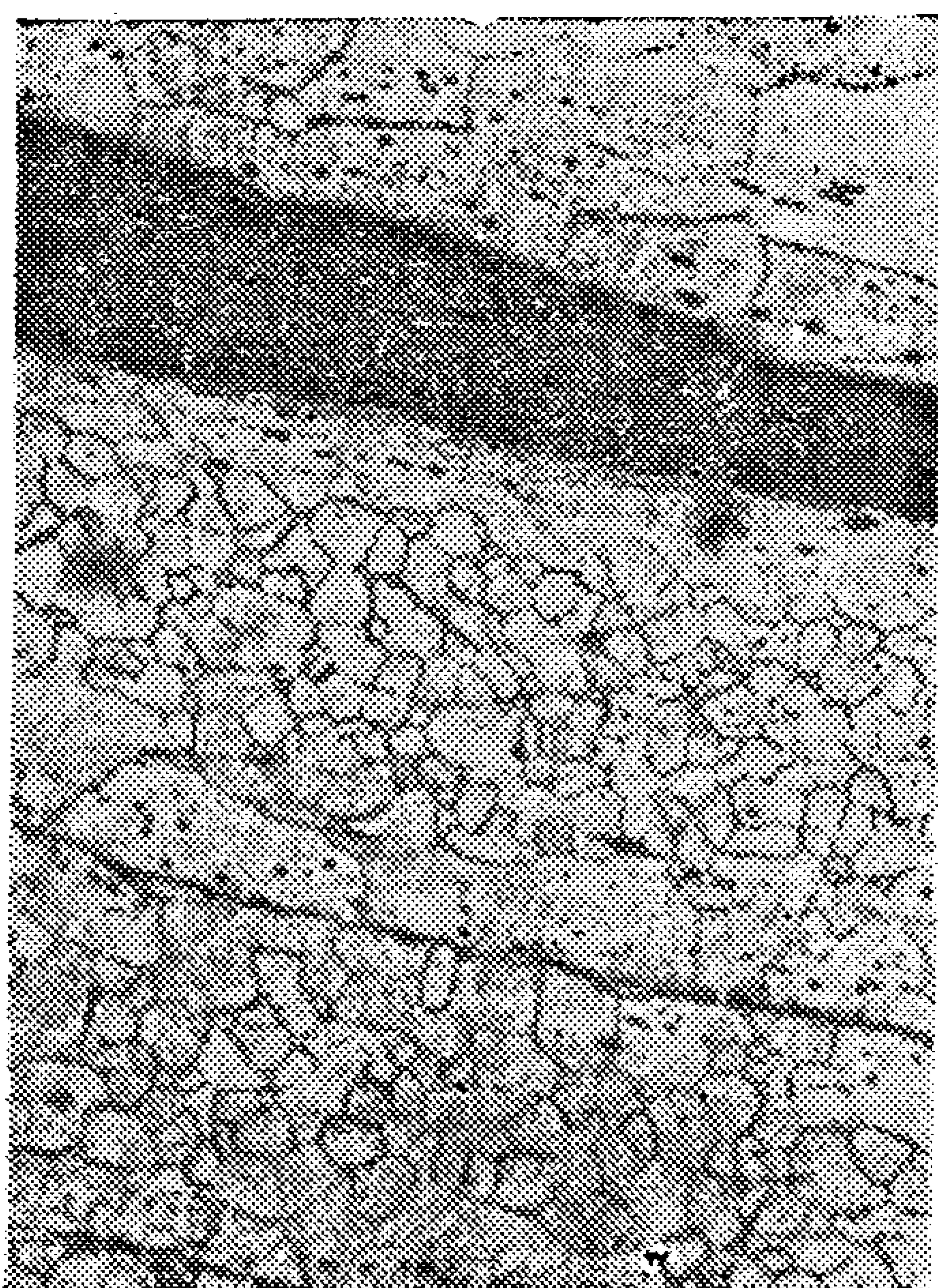


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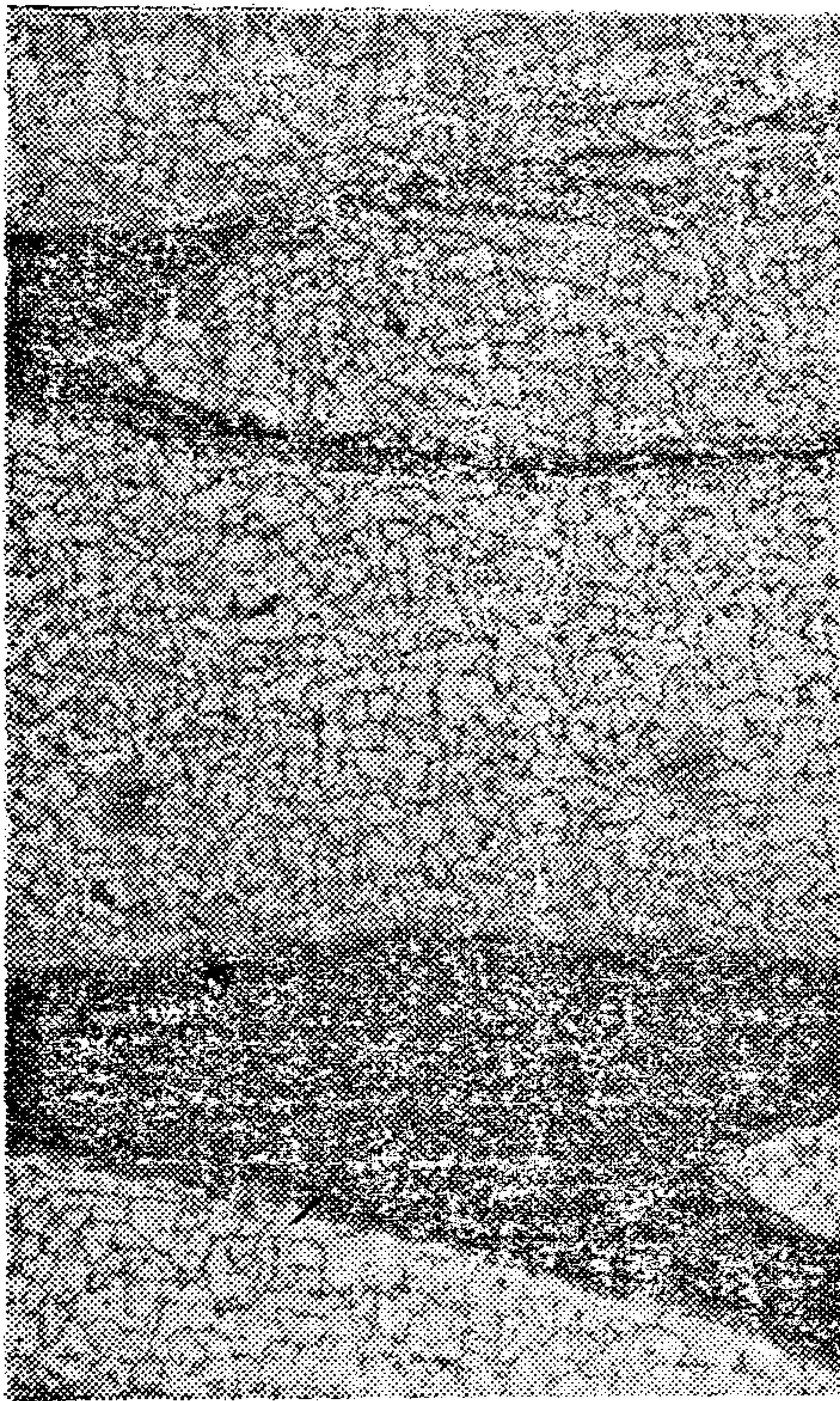
Fig. (3) : Specimen No. 2. Etched; e 200X; F 400x; g 1000x.



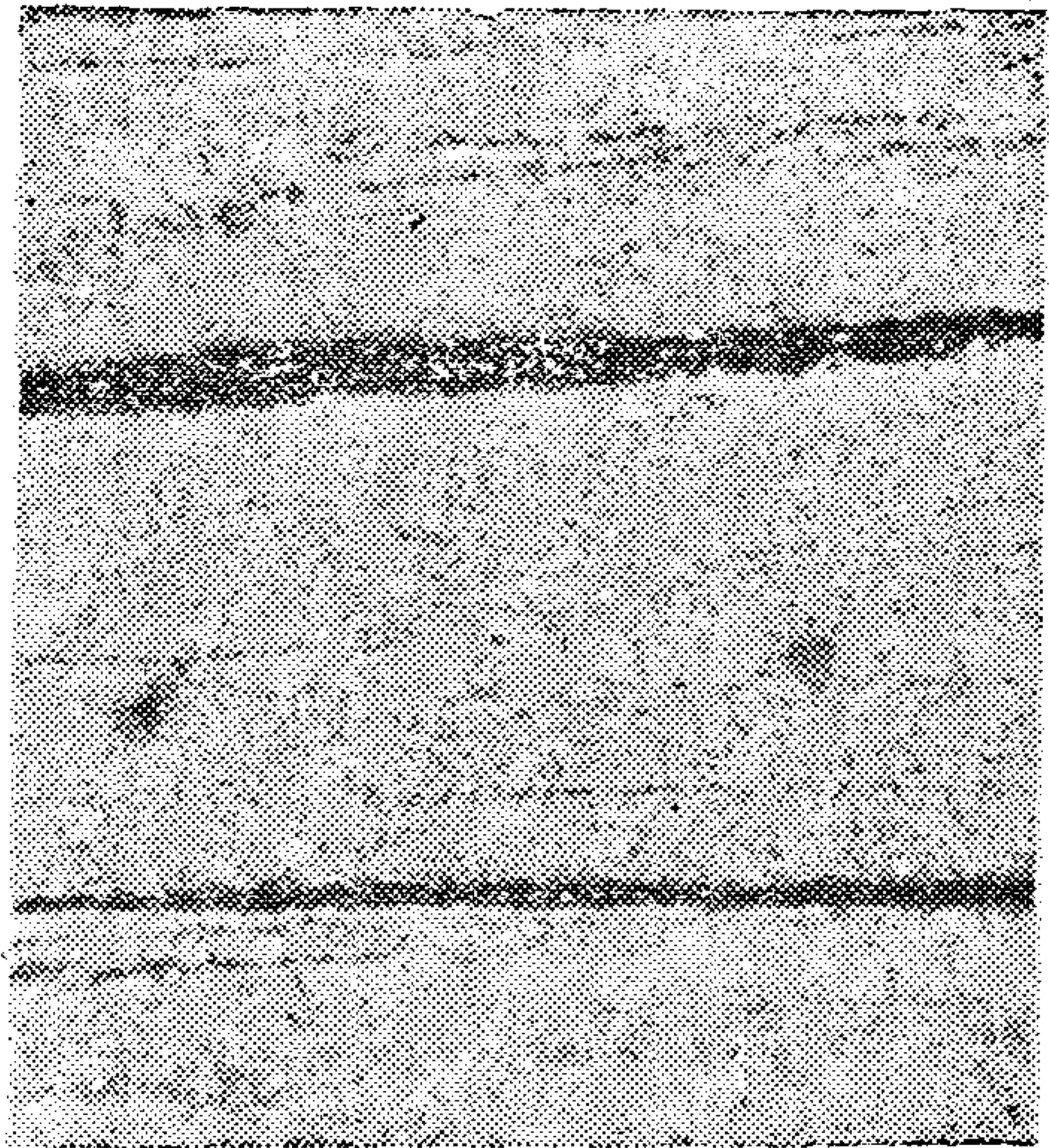
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Figures (4,a) and (4,b) show the microstructure of the specimen No. 3. The surface layer of rolling scale is followed by fine unequal grains. After the area of fine grains an oxidized film is seen under which another area of coarse grains with marked decarburization. Some pearlite is encountered in the lower part of the micrograph.

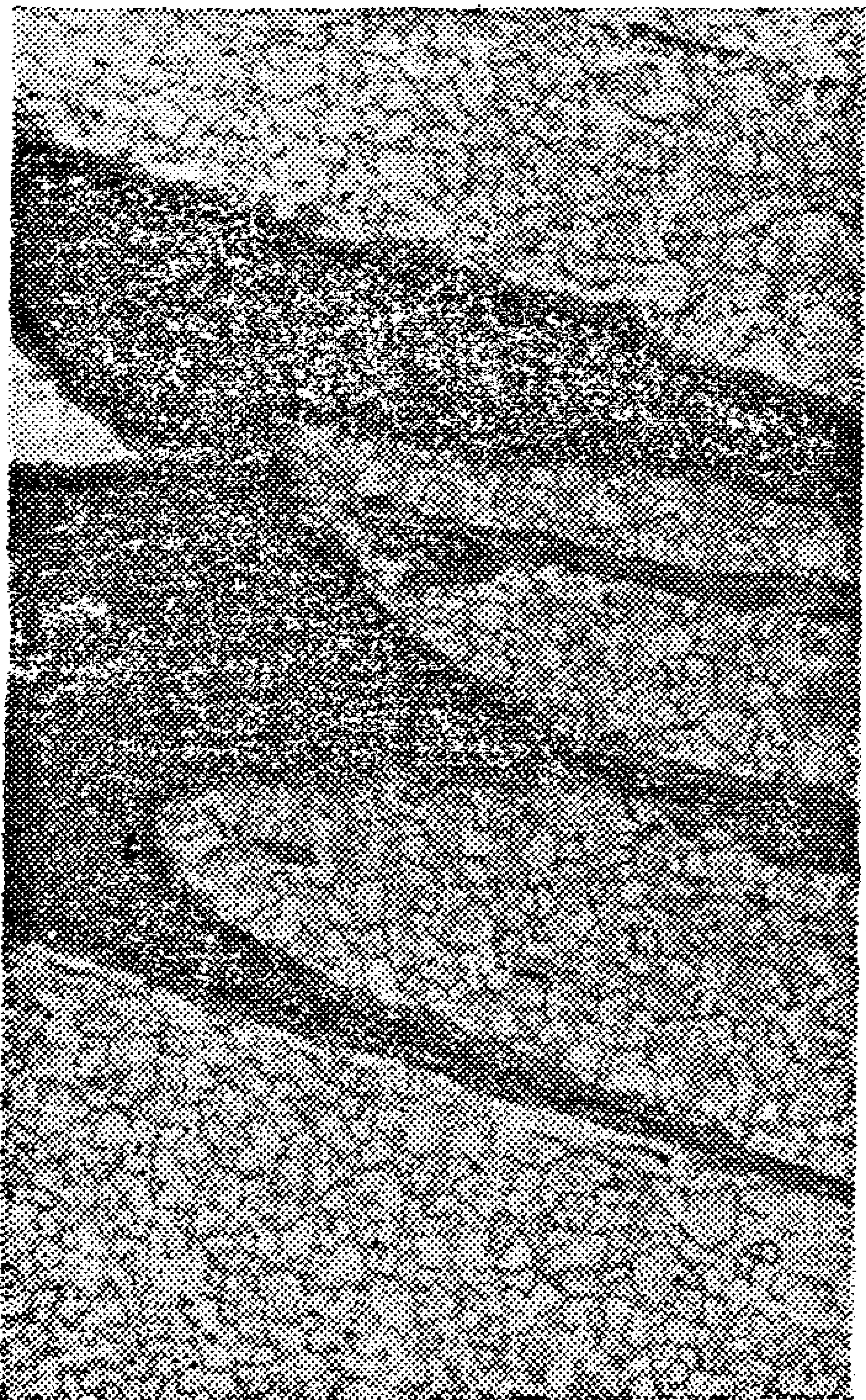
Figure (5) shows the microstructure of specimen No. 4 which was the only specimen taken in the transversed direction. Blowholes surrounded by large grains with many nonmetallic inclusion are seen. Nonuniform grain size occurs near to area of oxide films.



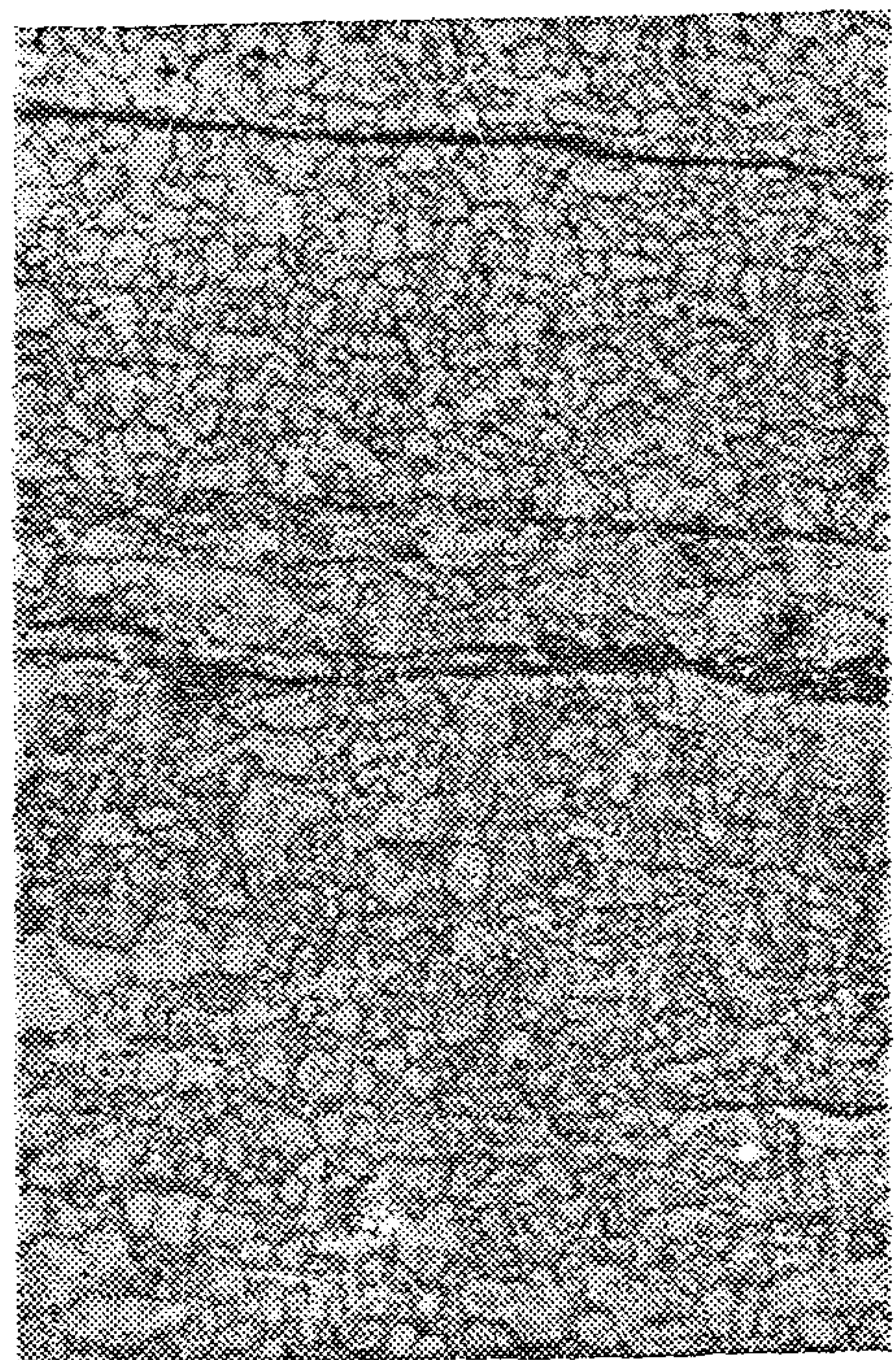
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c

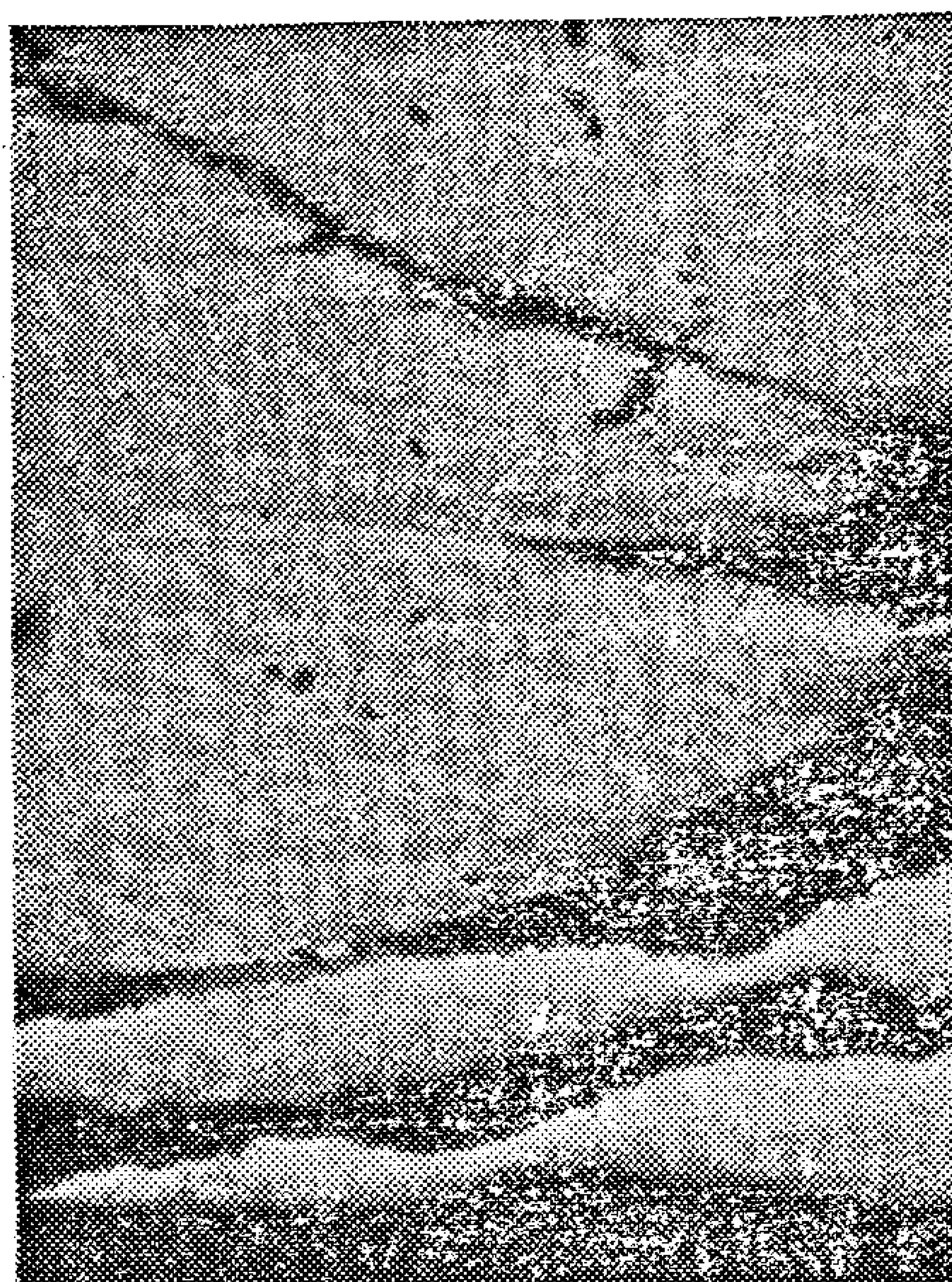


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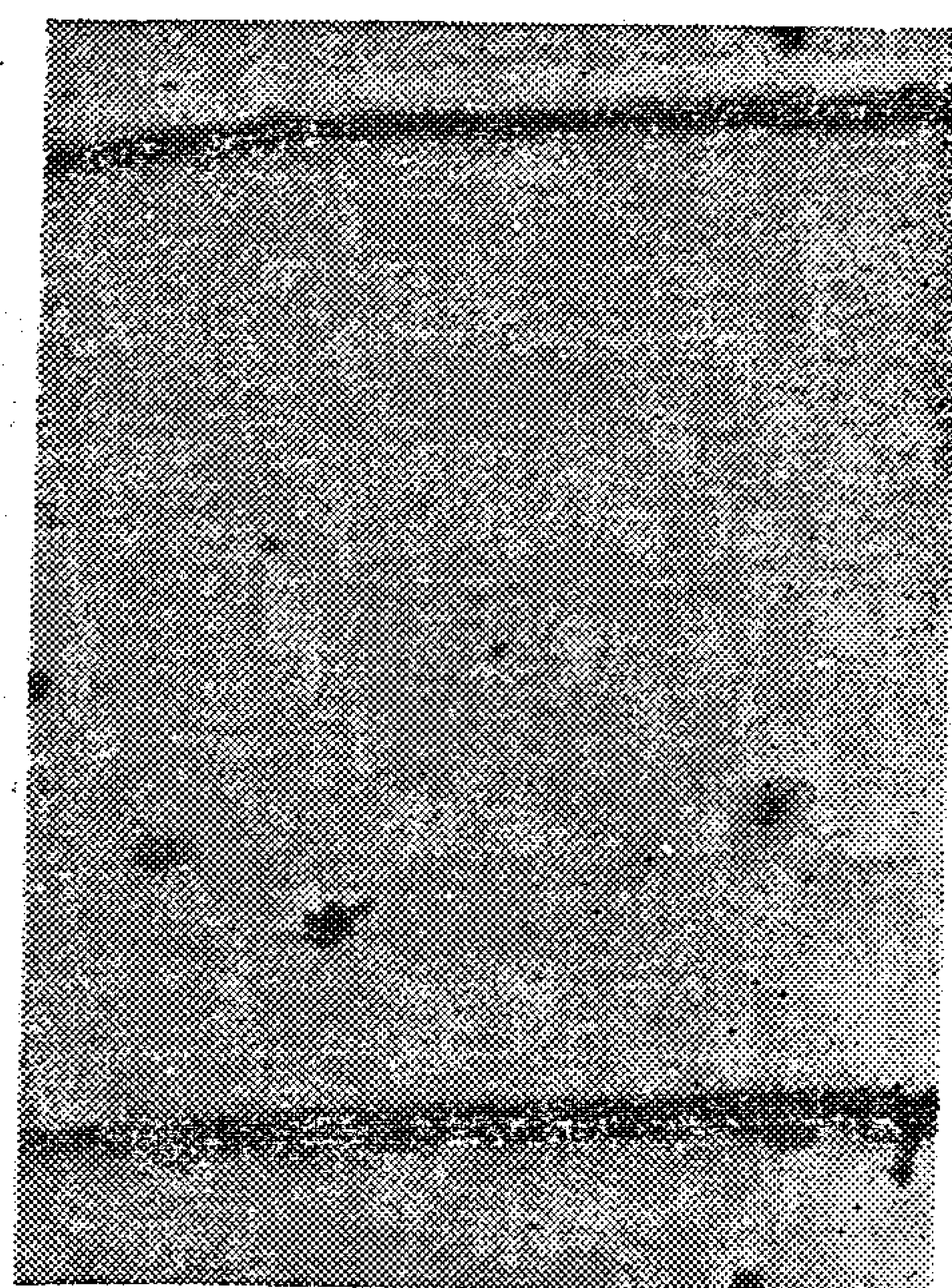


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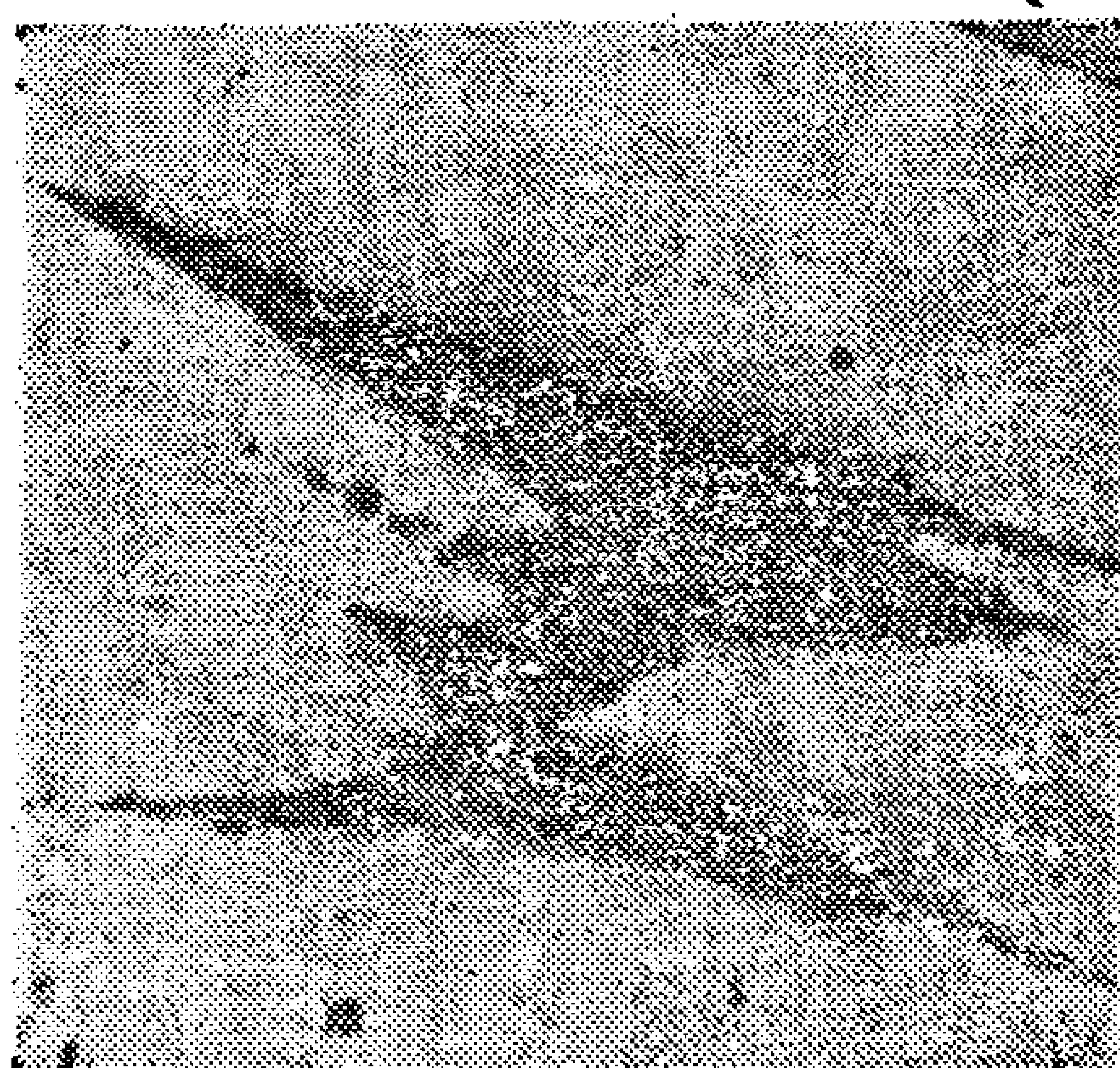
Fig. (3) : Specimen No. 2. Etched; a,b,d 200X; c 100X.



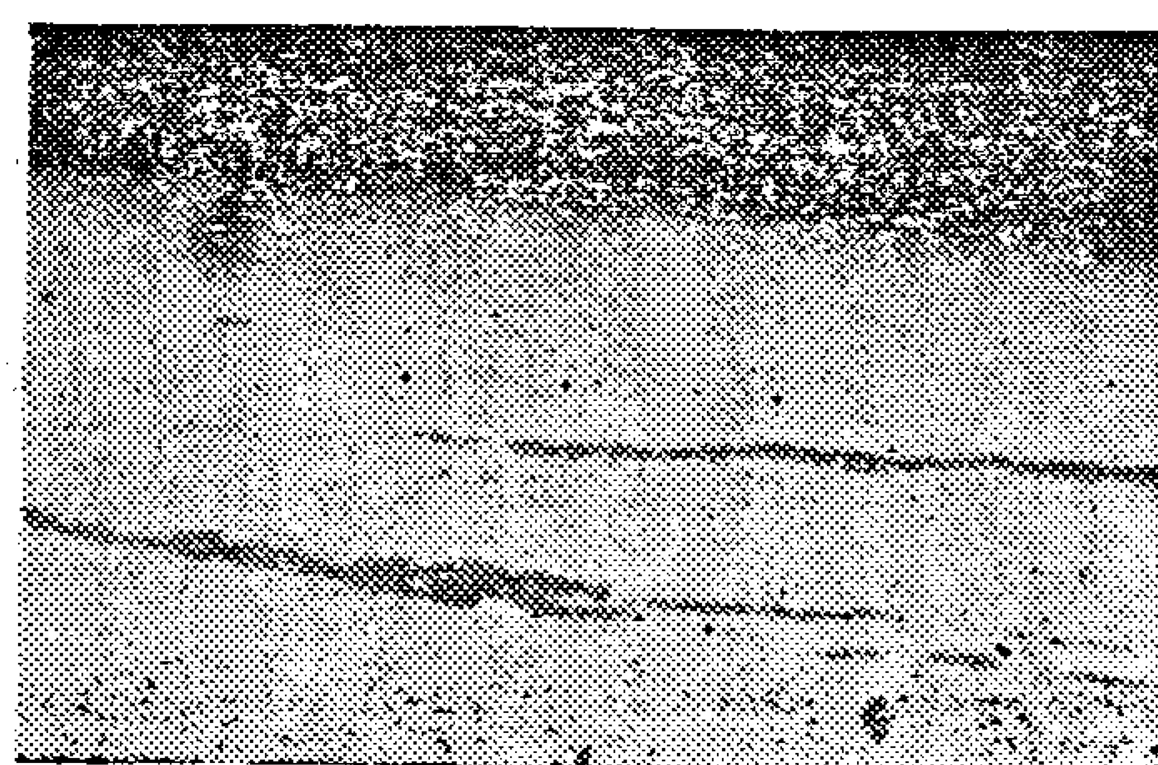
a



c



b



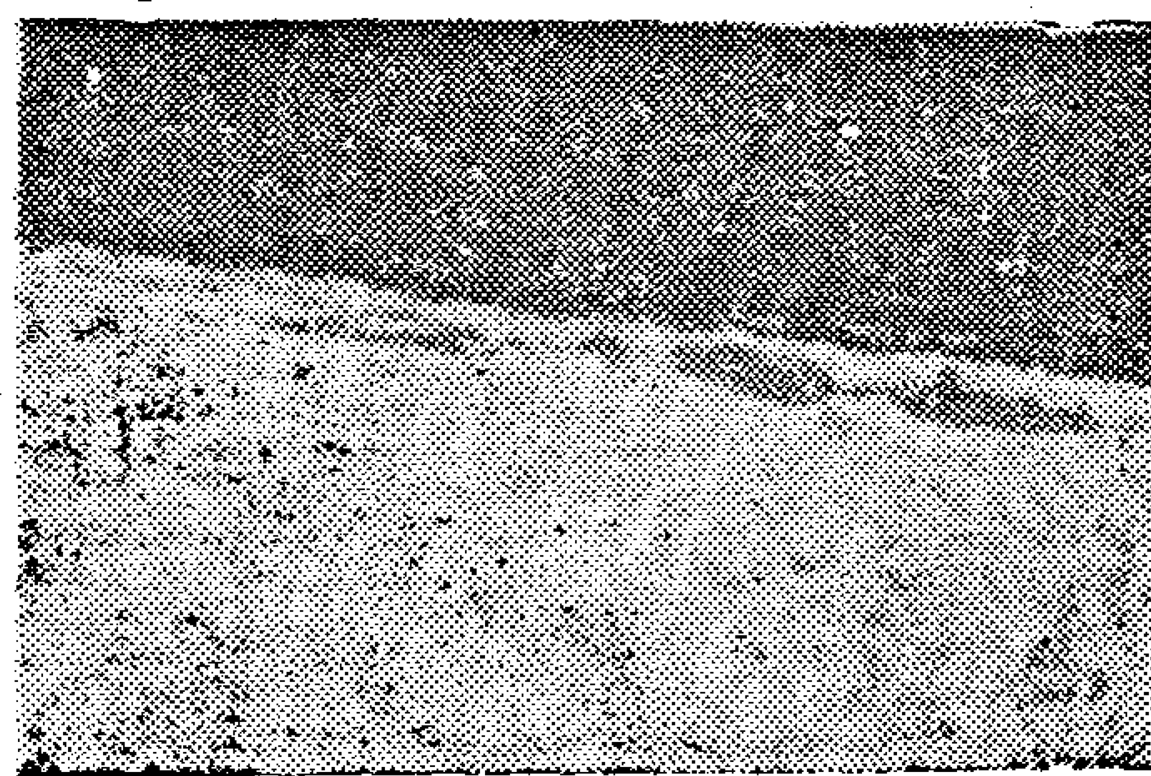
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Fig. (2) : Specimen No. 2 (unetched)

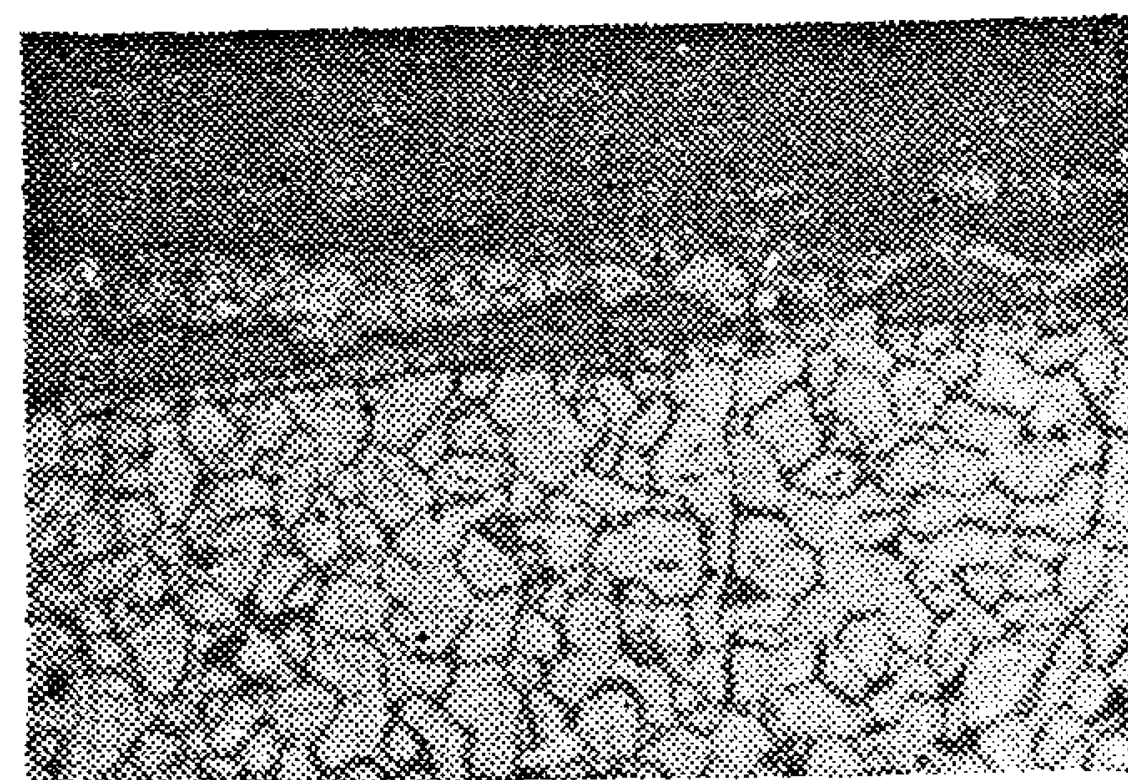
3. RESULTS AND DISCUSSION

Figure (1) shows the microstruture of the specimen No. 1. In Fig. (1,a) (unetched) subsurface oxide films are seen. From Figs. (1,b) and (1,c) (specimen No 1 after etching), it is clear that the subsurface oxide film is similar to surface scale layer. Some elongated nonmetallic inclusions are also seen. The microstructure consists of ferrite and pearlite, with marked decarburization near the surface. Thus, even specimens without marked edge cracking may develope some subsurface defects.

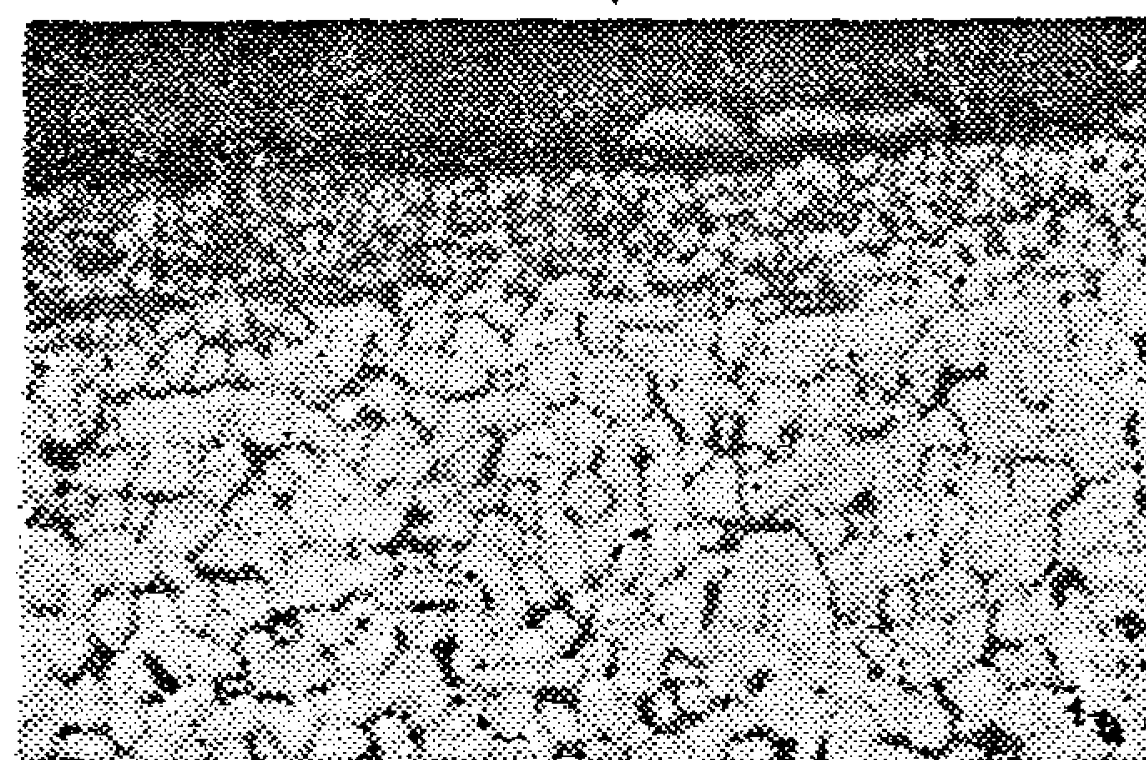
Figures (2) and (3) show the microstructure of the specimen No. 2. From Figs. (2,a) and (2,b), the existence of oxidized blowholes which are open at the metal surface is very clear. Many nonmetallic inclusions are seen near the oxidization blowhole. Figures (2,c) and (2,d) show tails of blowholes. In Figs. (3,a) and (3,b) branched blowholes surrounded by nonuniform grain size are shown (after etching). Coarse grains with marked decarburization are seen near to the oxidized blowholes. Figures (3,c) and (3,d) show different zones with different grain size, which is the result of nonuniform rolling reduction in various areas. Figure (3,e) indicates that large grains occur near the blowholes. These grains contain a great number of rounded nonmetallic inclusions. Figures (3,f) and (3,g) show elongated and isolated oxide films with many small nonmetallic inclusions. These oxide films are the continuation of the oxidized blowholes inside the metal.



a



b



c

Fig. (1) : Specimen No. 1. 200X

also exist they are caused by insufficient cleaning of the cast slabs and insufficient removal of slag and scale during rolling. The removal of these defects is usually done by shearing and in rare cases by polishing.

Internal defects such as lamination consist in division of the metal into layers these layers may be seen in the cross section of the sheet or at the edges. Defects of initial cast slabs and in rare cases non-metalic inclusions cause this defect. It can be removed by shearing.

2. MATERIALS AND EXPERIMENTS

Low carbon steel slabs produced by continuous casting in the Egyptian Iron and Steel Co. The slabs were then hot rolled on semi-continuous strip mill. Some slabs showed edge cracking. Specimens were taken at the cracked areas. The chemical analysis of the investigated specimens was as follows :

Table (1) : Chemical Composition.

C%	Si%	Mn%	P%	S%	Al%
0.1	0.11	0.51	0.029	0.014	0.004

Their average mechanical properties are shown in Table (2).

Table (2) : Average mechanical properties of the investigated specimens.

σo	UTS	σ %	Gran Size
25 kg/mm2	35.7 kg/mm2	32.7%	7.9 ASTM

Edge cracked specimens were investigated metallographically along the rolling direction and perpendicuar to rolling direction, Table (3) shows the different investigated specimens and their contions.

The metallographic study was carried out using etched and unetched specimens. Also the specimens were investigated under a scanning microscope. Analysis of the main elements of inclusions was performed using scanning electron microscope.

Table (3) : Investigated specimens.

Specimen No.	Diretion of Cutting	Specimens Condition
1	RD (Rolling Direction)	Without apparent edge cracking
2	RD (Rolling Direction)	near the edge crack (about 5 mm from edge)
3	RD (Rolling Direction)	far from the edge crack (6-8 cm from edge)
4	TD (Transversed Direction)	near edge cracking.

reheating furnace. Rolled blowholes or pinholes can be removed by shearing.

Ulcers (small depressions) are the result of low level of deoxidation or from unfavourable casting conditions. They have the shape of oval. To prevent these defects heating time and furnace atmosphere should be kept within accepted levels. In some cases this defect can be removed by shearing. When pinholes are found in great quantities they are called ulcer cracks. These depressions may be filled with scale. They result from low level of deoxidation or from unfavourable casting conditions. In some cases this defect can be removed by shearing.

Rubbles result from internal defects such as gases and nonmetalic inclusions which are caused by continuous casting or casting in moulds. These bubbles make complete welding during rolling impossible and they can be removed by shearing of the defected regions.

Cavities result from scarfing cavities or solidification cavities. Cavities are prevented by avoiding too deep scarfing, and may be removed by shearing.

Longitudinal cracks along the initial axis of the slabs, mainly on the wide faces of the slabs can be found as a result of low quality steel making and improper heating (nonuniform or sharp heating). These cracks can be removed by shearing. Non continuous curved cracks (tortuous) with random direction can be formed due to insufficient or nonuniform heating which leads to various strains in hot or cold areas. These cracks can be removed by shearing if their number is not too great.

Transvers cracks which are perpendicular to the original axis of the slab or ingot can be found. These defects are the result of discontinued pouring and sticking of the metal in the mould or due to defeects of rolling technology (heating problems). These can be removed by shearing.

Unwelded cavities are rolled unwelded volumes of the metal which are observed on the surface or in the cross section of the sheets. They are usually covered with scale and decarburization areas and are sometimes observed in the form of longitudinal defects along the edges of the rolled sheet.

A network of cracks which are encountered at the edge and on the surface of the rolled sheets are called burning. They are caused by excessive heating teemperaturd and time. In these conditions oxygen penetrates though the surface along the grain boundaries. They are prevented by avoiding any flame tongues which contact the metal surface and keeping proper heating conditions in the furnace. Burned metal is unfit for any application because burning cannot be removed.

Red shortness appears in the form of cracks caused by low melting eutectic of Fe-FeO-Fes located along grain boundaries. They occur mainly in steels with low carbon and manganese content. This type of defects are caused by high sulphur and oxygen content in steel and improper rolling temperatures. Sulphur and manganese should be with standard composition and the finshed temperature of rolling should be kept within the range 900 to 950°C.

Dents are depressions on the sheets surface having periodical character or random distribution. Sticking to the rolls, scale or slag remaining on the metal surface or oxidized splashes during casting may cause this dents type of defect. In order to prevent, the metal surface and rolls should be kept clean. Additional shearing may be used to remove them.

Defects such as rolled in scale and slag in the form of rugged uneven depressions on the surface of the metal with regions of nonmetalic appearance, may

(1) Insufficient deoxidation before continuous casting.

(2) Increased moisture content in the protective slag forming mixture.

(3) Defected tundish surface or nozzle.

(4) Bending inward of oxidized skin layer.

(5) Gas formation from the lubricating material at the edges of the crystallizer.

Several methods to prevent this type of defect are used. These methods are:

(1) Sufficient deoxidation.

(2) Sufficiently high rate of refining and strong enough boiling action of the molten metal.

(3) Decreasing the height of fall of metal stream during casting.

(4) Using optimum pouring (casting temperature).

(5) Protection of the surface of the molten metal in the crystallizer from oxidation and picking nitrogen by using closed stream casting and synthetic slags.

(6) Using optimum rate of casting.

(7) Moisture content of the protective slag forming mixture must not exceed 0.3%.

(8) The level of the metal surface in the crystallizer should be constant.

(9) Maintaining the optimum temperature conditions of melting.

Belts, platings and bleeds are all defects differring only in their dimensional development.

Belts are formed when the feeding of liquid metal into the crystallizer is discontinued. Excessive fall of metal temperature especially when pouring cold metal may also lead to belts. Rough belts cannot be removed by scarfing and lead to refused defected metal. Fortunately, belts occur very rare,

Plating are obtained when oxidised crust is drawn from the meniscus on the surface of the slab. This defect is mainly obtained when the speed of casting is low, when pouring cold metal or when the lubrication of the crystallizer is not satisfactory. Plating may be prevented by using protective slag mixture or protective atmosphere of argon, propane or natural gas.

Bleeds are obtained when the feeding of the molten metal into the crystallizer is stopped. In this case the outer skin of the solidified metal along the perimeter of the slab will shrink with the result that a part of metal skin will leave the crystallizer wall. On the renewal of pouring liquid metal will pass through the clearance between the wall of the crystallizer and slab surface forming so called bleed or poured outmetal. Bleeds can be prevented by avoiding closing of the nozzles, maintaining constant level of the metal in the crystallizer and avoiding sharp fall in the speed of drawing down the slab.

1.2. Hot Rolling Defects

Several defects can arise during the hot rolling operation (Novokshenovaya 1984), these defects are rolled blowholes or pinholes, ulcers, cavities, longitudinal cracks, tortuous (curved) cracks, transverse cracks, unwelded cavities, red shortness, dents, scratches, rolled-in scale and slag, internal defects and burnings.

Rolled blow holes or pinholes are defects of various size and depth. These defects are located near to the edge of the sheet. They are caused by gas bubbles which remain in the steel as a result of bad oxidation of melting and casting conditions. When blowholes are located near the edge, they may rupture. It is important to keep strictly the established heating time and the optimum composition of the furnance atmosphere in the

STUDY OF EDGE CRACKING OCCURING IN HOT STRIP MILL OF THE EGYPTIAN IRON AND STEEL COMPANY

M.R. El-Koussy and Nahed A. Abdel-Rahim Aly

ABSTRACT

The causes of edge cracks which appear during the hot rolling process in some of the sheets produced by the Egyptian Iron and Steel Company were investigated. These sheets are made of low carbon steel. Cracked specimens were investigated along the rolling direction and perpendicular to rolling direction. A metallographic, fractographic (scanning) studies were performed and chemical analysis of non metallic inclusions was carried out.

It was shown that the specimens were full of blowholes and non-metallic inclusions near the surface. These subsurface blowholes might be due to improper deoxidation and continuous casting conditions before hot rolling process. Since these blowholes are located very near to the surface, they can be opened during heating (due to scaling) or during hot rolling. Oxidation occurs in the opened blowholes. Many of the non-metallic inclusions found near the crack were similar in appearance to the surface scale, which indicate that they are of the same origin.

I...INTRODUCTION

I.I. Continuous Cassting Defects

The mechnical and physical properties of cast steel products are significantly influenced by the solidification of the steel. This influence is even more intense in continuous casting than in ingot casting because of the intensely anisotropic solidification structure usually found in continuously cast steel. Cracks can be present on the surface, corner, longitudinal and transverse. In the interior, cracks occur near the surface, half way between the surface and centreline and along the centreline. The crack paths tend to be related to the cast structure and microsegregation. There are different types of defects in continuous casting slabs which will be discussed below in detail. These defects might lead to crack (C.C.D.G. 1967, Concest A.G. 1981) they are:

(1) Skin blowholes and pinholes.

(2) Belts, plating and bleeds.

Skin or subsurface blowholes in the form of rounded or elongated cavities filled with gases may be very close to the surface or may even extend to the surface. These blowholes are usually located in the most cold places of the solidifying slabs. Greater number of blowholes are encountered near narrow slides and angles. Pinholes have been attributed to high levels of oxygen and hydrogen in the steel. If skin blowholes extend out to the surface or if they lie very close to the surface they may be exposed to scaling during heating leading to the formation of seams or cracks during hot rolling. There are many factors which lead to the formation of skin blowholes, these factors are listed below :

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CONCLUSION :

The study of linear displacement in the Rudies reservoir model results in the following conclusions.

1 Hot flooding increases oil recovery above conventional water injection. The recovery with displacing water temperature is about 1.8 percent recovery factor per 10°C on average. By injecting water at 80°C, additional 9.8 percent of OOIP may be recovered over that recoverable by conventional flooding.

2 — The effeicincy of polymer flooding increases with polymer concentration (in the slug) and the slug size. With polymer concentration of 1000PPm and slug size of 50 percent P.V., a recovery factor as high as 50.8 percent OOIP is obtained.

3 — Best results are obtained when a combined polymer-hot water flooding technique is applied. With a polymer slug of 25 percent P.V. and 500 PPm concenration, a recovery factor of more than 57 percent have been attained by following this slug by hot sea water at 80°C.

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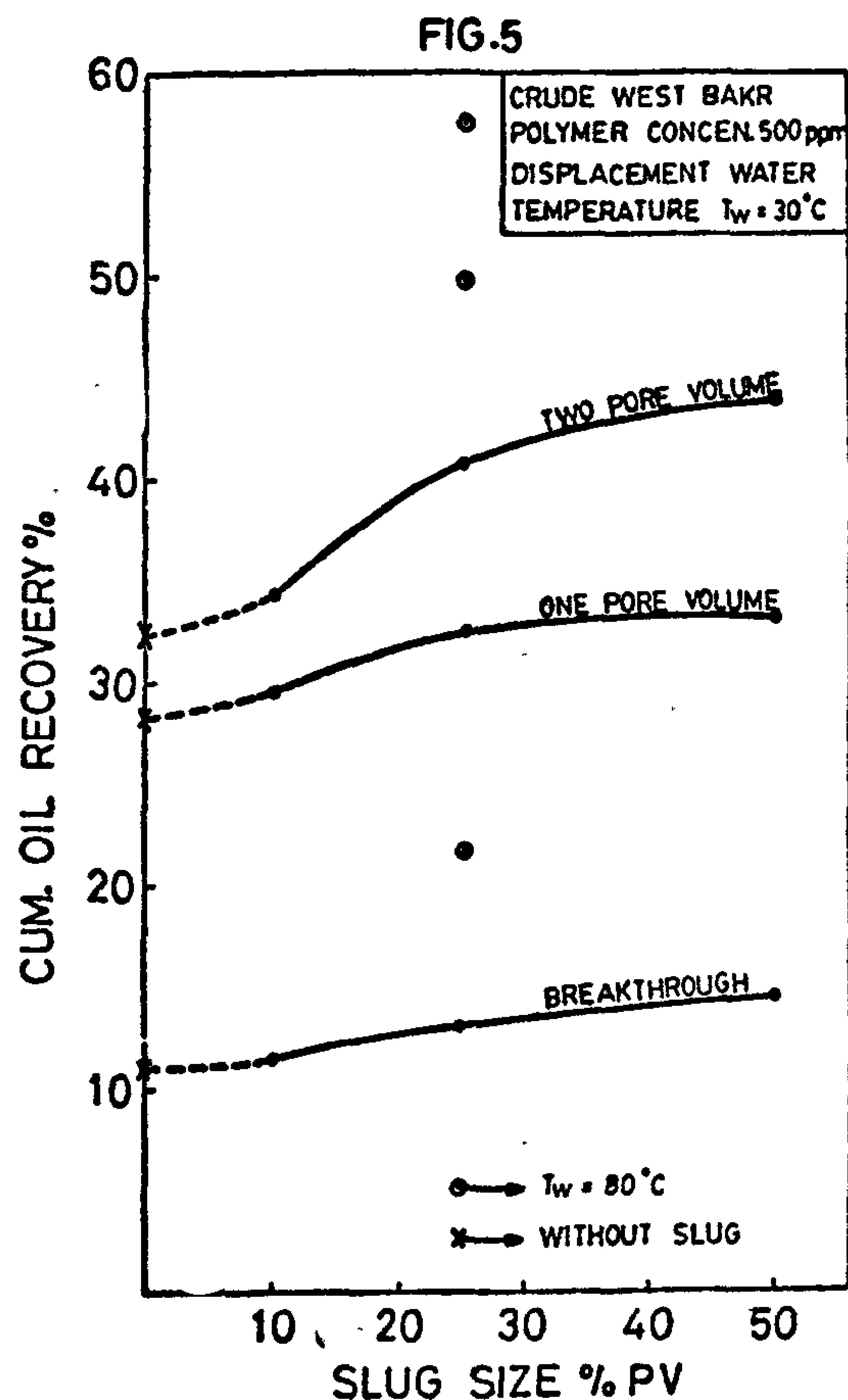
injected followed by sea water at the above mentioned temperatures. In all runs the temperature of sand pack was held constant at 60°C. The results of these runs are shown in fig. 6. and plotted in Fig. 3.

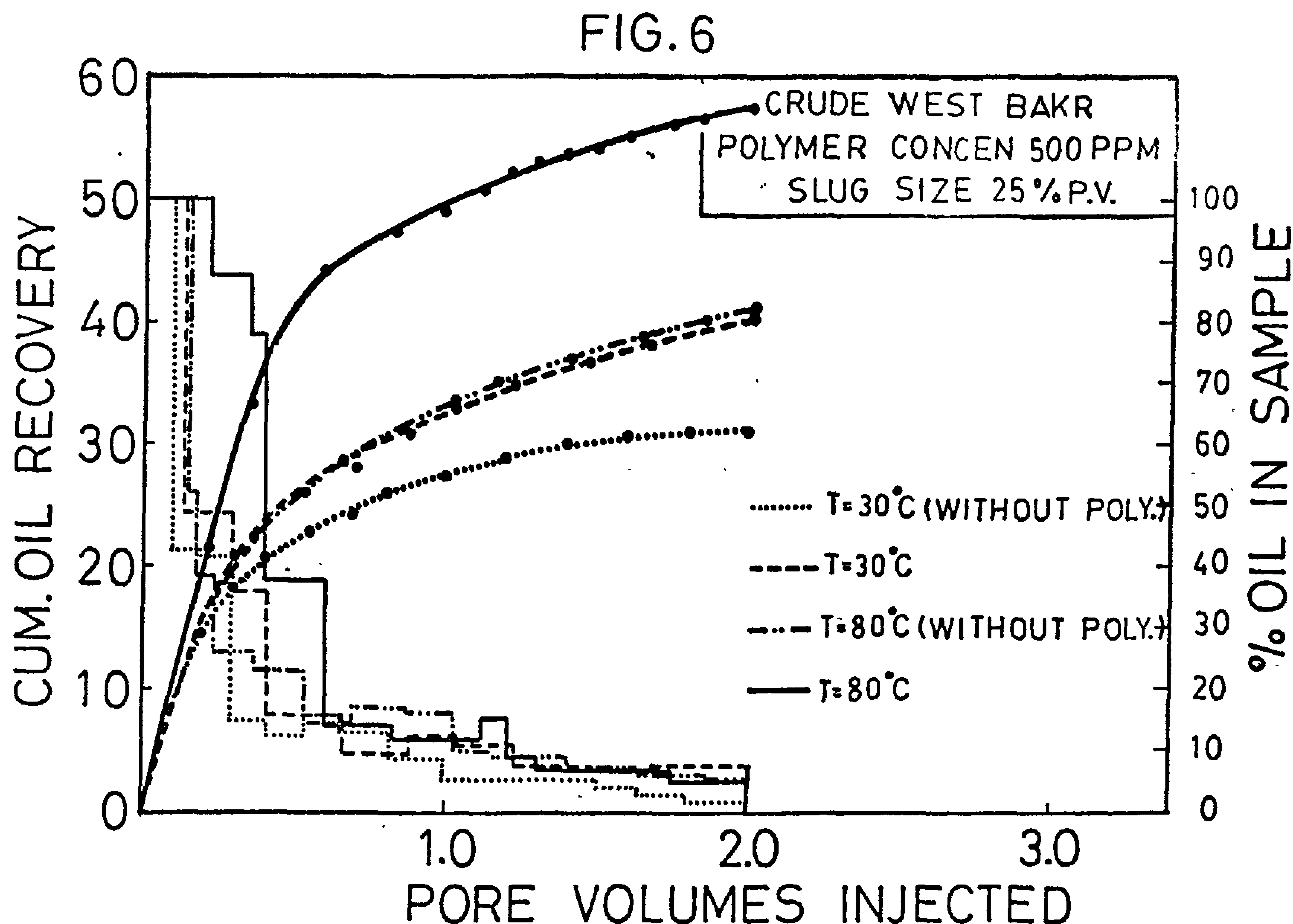
It can be noticed from fig. 6 that:-

— The highest value of recovery factor (57.5% OOIP) was obtained in the case of using polymer slug followed by hot water injection.

— The lowest value of recovery factor (32% OOIP) was obtained in the case of water injection at 30°C without polymer.

— The value of recovery factor in the case of using hot water (at 80°C) displacement (41.4% OOIP) is nearly equal to its value in the case of using polymer slug followed by water injection at 30°C (40.7% NOIP).





(ii) **Effect of Slug Size :**

A series of runs was conducted to determine the effect of slug size. In this series the polymer concentration of 500 P.P.M. in sea water was shosen. In all of these runs the temperature of the porous material was held constant at reservoir temperature of 60°C while the displacing fluid was held at 30°C. The slug sizes investigated were 0, 10, 25 and 50 percent of the pore volume. The result of this series are shown in table 2 and Fig. 5. It can be noticed that increased slug size leads to higher recovery. The Significant inrease is obtained in the range of 10-25% P.V. slug size.

iii-Effect of Temperature :

Four displacement runs were selected to show the combined effect of temperature and polymer on the oil recovery. In the first and secon runs, the crude was displaced by sea water without polymer at 30°C and 80°C respectively. In the other two runs a slug of polymer was

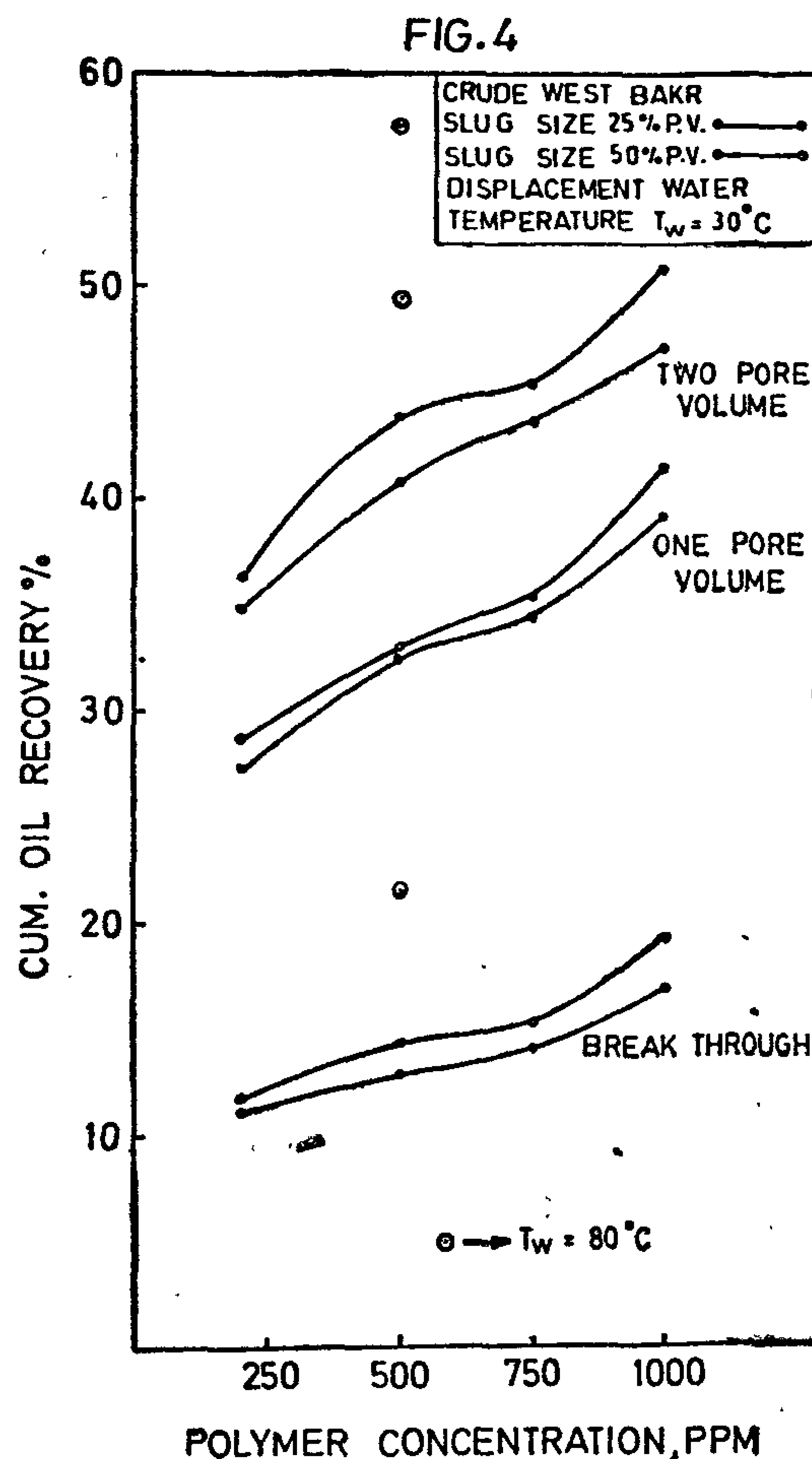


TABLE (2)

RESULTS OF CHEMICAL DISPLACEMENT (USING POLYMER) FOR WEST BAKR CRUDE

Model Temp = 60 °C water Temp = 30*C

POLYMER CONCENTRATION PPm.	RECOVERY FACTOR %					
	SLUG SIZE 25 % P.V.			SLUG SIZE 50 % P.V.		
	BREAK THROUGH	ONE PORE VOL.	TWO PORE VOLS	BREAK THROUGH	ONE PORE VOL.	TWO PORE VOLS
200	11.3	27.4	35	11.7	28.6	36.2
500	12.8	32.5	40.7	14.39	33	43.8
	21.7*	49.6*	57.5*			
750	14.0	34.2	34.6	15.2	35.2	45.2
1000	16.95	39	47	19.3	41.4	50.8
At Polymer Concen. 500 PPm. and Slug Size 10% PV.	11.4	29.4	34.2			

* Temperature of displacement water = 80 *C

Table (1)

RESULTS OF HOT WATER DISPLACEMENT FOR WEST BAKR CRUDE OIL

Reservoir Temp. 60 °C

Model Diameter 4.7 CM.
Model Length 80 CM.

PERMEABILITY m.d.	PORE Vol c.c.	POROSITY %	DISPLACEMENT WATER TEMP °C	RECOVERY FACTOR %		
				BREAK THROUGH	ONE PORE Vol.	TWO PORE Vol.
4300	392	28.2	25	10.6	27.6	31.6
410	395	28.4	40	12.1	29.8	34.3
4400	390	28.1	60	13.7	32.3	39.2
4200	389	27.4	80	15.4	33.8	41.4

Displacement Water Temp. °C	Recovery Factor %	Rate of Increase of R.F./10 °C.	average rate of increase
25	31.6		
40	34.3	1.8	
60	39.2	2.45	1.8
80	41.4	1.1	

The above table shows that the maximum increase of recovery factor with temp. (2.45%/10°C) occurs in the temperature interval 40 - 60 °C (in other words when temperature approaches sand pack temperature of 60 ° C . The minimum value of the above mentioned rate (1.1/10°C) occurs at water temperature interval 60-80°C (higher than sand pack temperature) due to the loss of heat energy to the surrounding medium. Over the temperature range investigated, the recovery factor increase is 1.8% for every 10°C.

(b) **Polymer Flooding :**

Several polymer flooding runs have been conducted in order to determine the effect of different displacing parameters. The parameters investigated are polymer concentration, slug size and displacing temperature.

(i) **Effect of polymer concentration (in the slug)**

A number of runs were designed to determine the effect of polymer (Anti-gum) concentration on the recoverable oil. The temperature of displacing agent (Sea water) was 30°C for all runs of this series. The effect of slug concentrations of 200, 500, 750 and 1000 P.P.M was investigated.

The results are shown in table 2, and Fig. 4. From Fig. 4. it can be said that generally, oil recovery increases with increasing polymer concentration. The increase of recovery factor with concentration is more apparent in the range of 200-500 P.P.m. polymer concentration. The effect is less apparent in the concentration zone from 500 to 750, but starts increase again at higher concentrations.

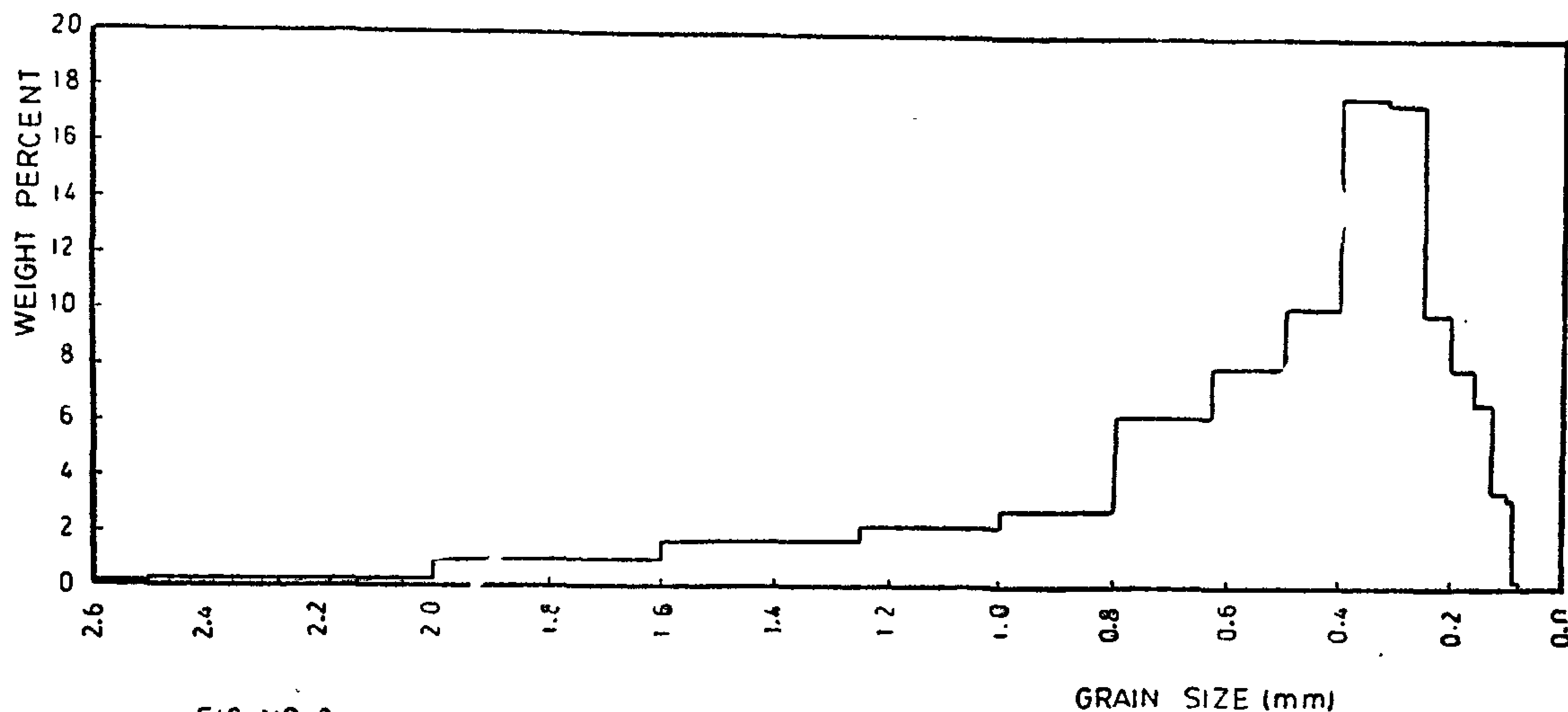


FIG NO 2

HISTOGRAM OF SAMPLE (RUDIES A SAND.WEST BAKR FIELD)

3 — Applying Vacuum on the sand model for 3 hours.

4 — Saturating the model with West Bakr crude oil (at actual reservoir temperature of 140° F, 60° C) using manual graduated pump to obtain the value of original O.I.P. and porosity. To insure complete saturation, two pore volumes were injected in the model before the porosity is calculated. —

Porosity = Oil Volume (in the sand pack) / Sand bulk Volume.

Experimental Procedure

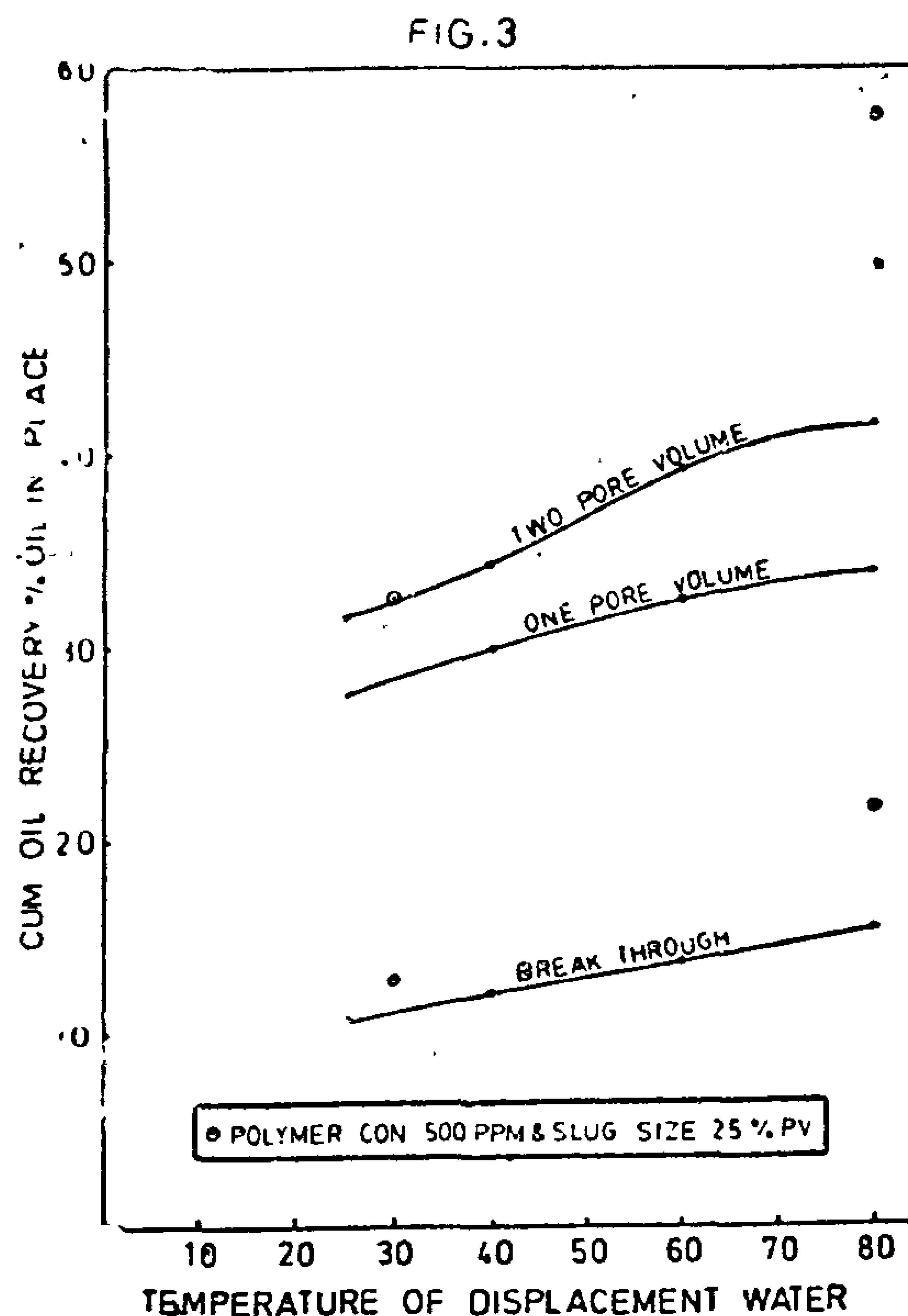
In all the displacement runs performed in this work, the temperature of the displaced oil in the sand pack was adjusted at 60°C (reservoir temp.) while the displacing agent temperature was adjusted to a predetermined value in each run. Cummulative oil and cummulative water produced were measured as a function of time in each run. Each run was terminated after the injection of two pore volumes sea water.

RESULTS AND DISCUSSIONS

(a) Thermal Flooding Runs

Several experimental runs have been conducted in order to determine the effect of hot water displacement on oil recovery (As shown in table 1). Fig. 3. Shows the variation of recovery factor with displacement water temperature (from 25°C to 80°C). Generally, oil recovery increases with increasing displacement water temperature. It can be easily shown that the rate of increase of recovery factor varies with increasing temperature.

FIG.3



In this work the increase of recoverable reserves from a linear reservoir model when subjected to polymer flooding and /or hot water flooding was investigated.

— EXPERIMENTAL WORK

Several linear displacement runs were conducted to study the effect of the different suitable EOR metods on oil recovery from Rudies «A» sand of west Bakr Field. The EOR methods investigated

1 — Hot water flooding.

2 — Polymer flooding.

3 — Slug of polymer followed by hot water flooding.

In all experiments, Sea water obtained from the Gulf of Suez (Red Sea) was used as the displacing agent.

Apparatus used

The apparatus used in this work is presented in fig. No. 1. The main parts are the cylinderical model (surrounded by jacket), Vacuum pump, displicement container (surrounded by jacket) and thermostats for adjusting both sand pack and displacing agent temperature.

Materials used in the study

1 — West Bakr Crude oil.

2 — Sea water (from the Gulf of Suez).

3 — Polymer solution (Antigum at different concentrations).

Preparation of a displacement Run:

For each run the following steps were followed:

1— Packing the cylinderical model with sand of the same grain size distribution as that of Rudies «A» sand Fig. No. 2.

2 — Hammering the model until an air permeability (by the aid of gasometer) nearly equal to actual reservoir rock permeability of Rudies «A» sand (3400 m.d.) is obtained.

1-CYLINDERICAL MODEL 2-GAS CYLINDER 3-CONTAINER
4-MANIFOLD 5,6-MANOMETERS 7,8-THERMOSTATS
9-GASOMETER 10-MANUAL PUMP 11-OIL CONTAINER

FIG.1 SCHEMATIC REPRESENTATION OF EXPERIMENTAL APPARATUS.

A LABORATORY STUDY ON ENHANCED OIL RECOVERY FROM WEST BAKR OIL FIELD BY HOT WATER AND POLYMER FLOODING

Mahmoud H. El-Batanoney*
Mohamed. H. Sayyouh***
Nasser A. Fawzy**
El-Abass A. Abass*

Abstract:

Rock and fluid properties of Rudies A sand, west Bakr field point out to hot water and polymer flooding to be the most suitable EOR methods to be applied in this reservoir. Linear displacement experiments have been conducted on Rudies A reservoir model to study the effect of hot water and polymer flooding on the reservoir model. In addition, the effect of a polymer slug followed by hot water injection was investigated.

In this work, the effect of displacement water temperature, polymer concentration in the polymer slug and the size of the slug on recovery has been studied. In the range of temperature studied (25-80°C) the increase of flooding water temperature increased recovery. The polymer concentration and the polymer slug size have effect.

Maximum recovery, however, was attained when combined polymer-hot water technique was applied. Using this method we were able to get a displacement effiecincy greater than 57 percent.

INTRODUCTION

The subject of increasing oil recovery by applying different enhanced oil recovery techniques has been extensively studied in the literature (1-8). Most of the published work, however, is qualitative in nature. Guide lines to choose a promising EOR method to apply to a certian reservoir have been reported by (9-14). However, their is no published method to calculate the additional reserves to be gaines by the chosen EOR method.

The First step to evaluate the results of an EOP project proposed for a certain reservoir is to conduct laboratory displacement experiments The rock-fluid system in these runs should resemble the reservoir characteristics. It is only after the laboratory work proves that the application of the proposed EOR technique is attractive a prototype project may be initiated.

Increasing the recoverable reserves from old Egyptian Fields is of great importance, specially for the reservoirs chrracterized by intermediate to heavy crudes. Large quantities of oil will remain-in-place in such reservoirs after primary and secondary recovery phases. One example of such reservoirs is west Bakr. Rudies "A" sand reservoir. Based on published literature (15, 16, 17, 18, 19, 20) andthe rock and fluid properties of the Rudies "A" reservoir (high permeability, low shale content, shallow depth and intermediate oil viscosity) hot water flooding and polymer flooding were chosen as the most suitable EOR techniques to be applied in this reservoir.

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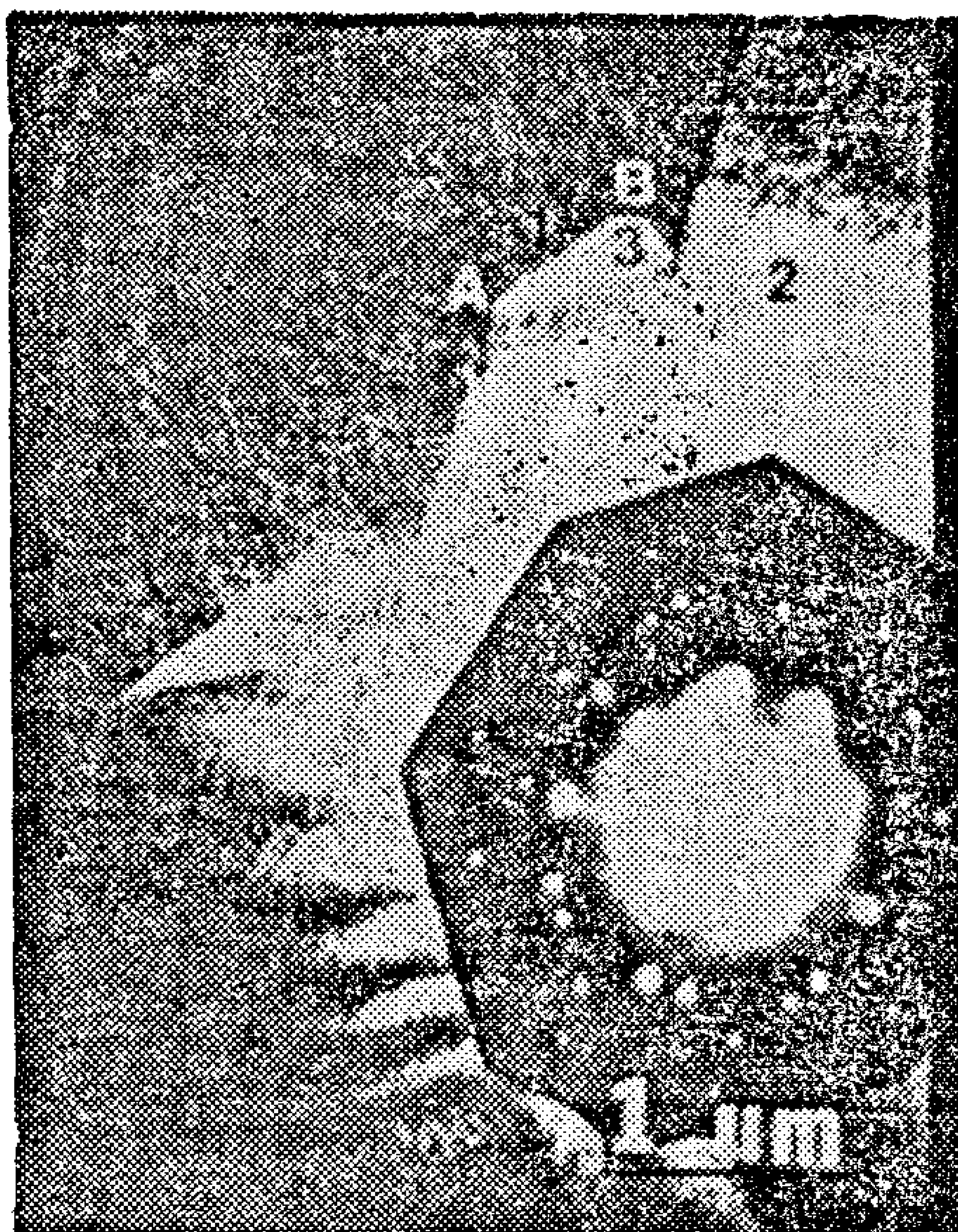
ACKNOWLEDGEMENT

The author is grateful to Dr. M.Z. Ibrahim for many helpful comments on the man uscript, and also whishes to thank Dr. R.C. Pond for encouragement and provision of facilities.

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prefere the symmetric boundaries because it show a lower energy and it reduce the number of variants produced due to loss of symmetry.

Fig. 3



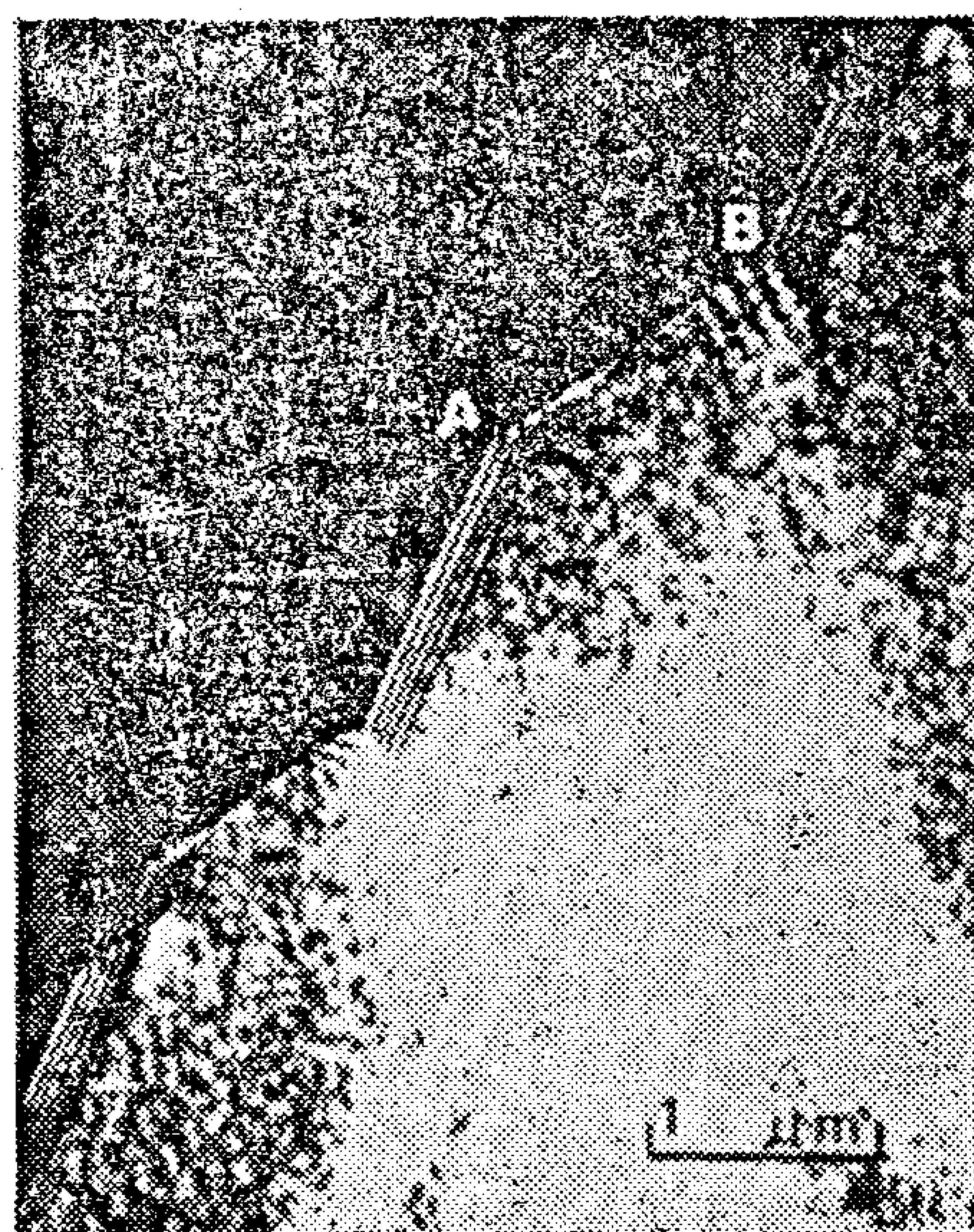
a



b



c



d

Transmission electron micrographes of a $\Sigma = 2^7$ boundary in silicon .

a- Bright field micrograph and diffraction using beam direction [011] the boundary is edge on.

b- Bright field micrograph and diffraction using another [011] beam direction as well as the diffraction pattern for the boundary AB.

c- Bright field micrograph, the beam direction is [111]

d- Bright field micrograph, the beam direction is [112]

by trace analysis. This method was chosen since it is simple and give accurate results as was described by Pond (11)., Vlachavas and Pond (4) and Bastaweesy(2)

4. Experimental Results :-

Fig. 3.a is an image using [110] many beam diffraction of the boundary region separating two crystals where the boundary is edge on. The upper and lower crystals in Fig. 3.a will be referred to as (1) and (2) respectively. This boundary can be described as a tilt boundary of misorientation angle $\Phi = 31.59^{\circ}$ about (110), and is denoted as $\Sigma = 27$ in CSL model discriptions (Grimmer et al. 12), Warrington and Grimmer (13)) In the axis angle pair notation, the boundary is described as $\Sigma = 27$ [110] 1,2/31.95. The two suffices indicate that for this CSL boundary the direction of the rotation axis is common to both crystals .

Fig. 3.b shows another [110] common diffraction pattern for the boundary between crysrals (1 & 2) as well as an image of the same area. It can be seen that crystal 3 has a different normal direction. This means that the orientation between crystals (1&3) and (2&3) is not the same as (1&2). the orientation relationship between (1&3) is $\Sigma = 3$, [110]/70.53,° and for crystals (2,3) can be described as $\Sigma = 9$. [110] /38.94.°

Figures 3.c and 3.d, show the same area using many beam diffraction conditions [111] and [112] respectively. The boundary plane show a stacking fault like fringes. This means that a discontinuous offest is present, i.e., the paralled planes are not aligned continuously in both crystals. Moreover, the magnitude and sense of any offset can be determined since the intensity of the stacking fault like contrast depends on the diffraction parameters. In this case it is quite difficult to obtain a common diffraction from three sets of planes sequentially whose normals are not co-planer. It can also be seen from these images that the boundary plane AB had disappeared in both diffractions. This means that the boundary AB is coherent.

5. Discussion and Conclusions :-

The dissociation observed for $\Sigma = 27$ boundary may be of generality, since dissociation produces a substatantially larger total grain boundary area than simple faceting. Faceting of grain boundaries has frequently been observed (see e.g. Vaughan (14)), however, such observations were on a coarser scale than the faceting of the $\Sigma = 3$ boundary. Brokmann et al. (15) proposed a model for "atomistic faceting" of symmetric tilt boundaries, they pointed out that the difference between atomistic, micro and macro-facting is "interaction energy" between the different facets.

It was reported by Cunningham and his co-worker (16-17) that the dissociation of $\Sigma = 27$ to $\Sigma = 3$ and $\Sigma = 9$ can not be detected by conventional diffraction contrast technique. The maximum distance between the products of the dissociated boundary is 15 nm. We believe that the observed boundary is quite complicated but it shows $\Sigma = 27$ as well as $\Sigma = 3$ and $\Sigma = 9$, and it was felt that the dissociation of $\Sigma = 27$ can be produced macroscopically as well as atomistically.

From the crystallographic work it can be seen that for all boundaries formed by rotation arround *[011]* common direction, two different relaxed models can be obtained. One is symmetric having the symmetry group p2'mm', and the other is assymmetric and shows a complicated type of dislocation arrays. These arrays are depending on the DSC (D stands for displacement of lattice 2, S for shift of the pattern and C for complete) away from the coincidence position. We

3 (211) twin boundary and the models of the same boundary has been done by Basteweesy (2).. The results of this work show two different structures; one having the symmetry group plml and the other is p2'mm'. Computer simulation of these structures showed that the model with maximal symmetry has got lower energy (see Pond et al (8)). Pavon et al. (9) have also suggested two models for $\Sigma = 9$, one of them is symmetric, i.e., having the symetry group p2'mm' and the other is unsymmetric. The symmetric structure is shown in Fig. 2.a and a dislocation with Burgers vectoro a [110] has been created by interpassing a six membered ring between the five and seven membered ones, forming a reapting unit (labelled D).

It is known that for reconstruction of the tetrahedral bonding the diamond structure crystals, odd membered rings are joined symmetrically to form dislocation core. The ends of this dislocation core are necessarily pointed. Hence two cores can not be joined directly together but must be connected by two six-fold rings as shown in Fig. 2.b. forming a unit A which is $\Sigma = 3$ twin boundary. From Fig. 2.c. a construction for $\Sigma = 27(552)$ twin boundary can be obtained as ADA combinations. The symmetry of the formed boundary is p2'mm', i.e., it is symmetric structure. Another unsymmetric structure can be obtained from Fig. 1.c. showing facets on (111) planes.

3. Experimental Technique :-

Thin foils of silicon are prepared by mechanical polishing to a thickness of about 100 μ m, followed by chemical thinning until the centre of the foil becomes transparent. The thin foils are examined using conventional electron microscopy operating at 200 kv. Crystals orientations are determined by electron diffraction, then the boundary planes are established

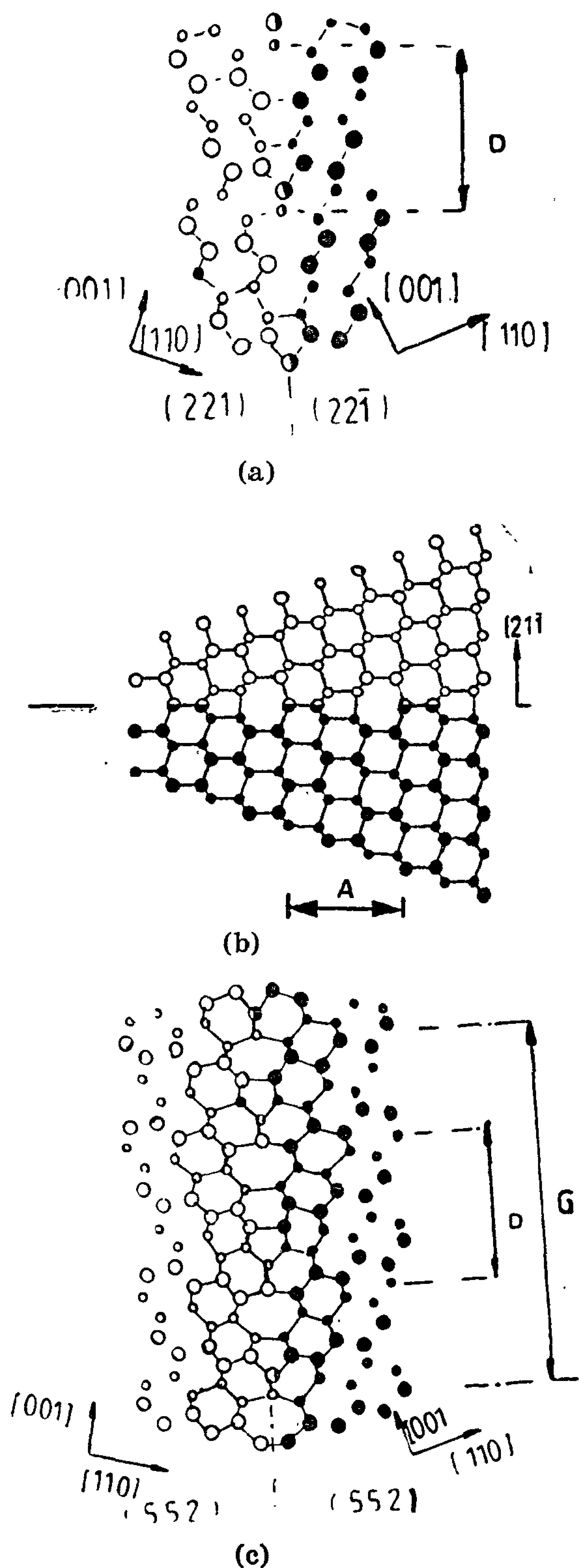
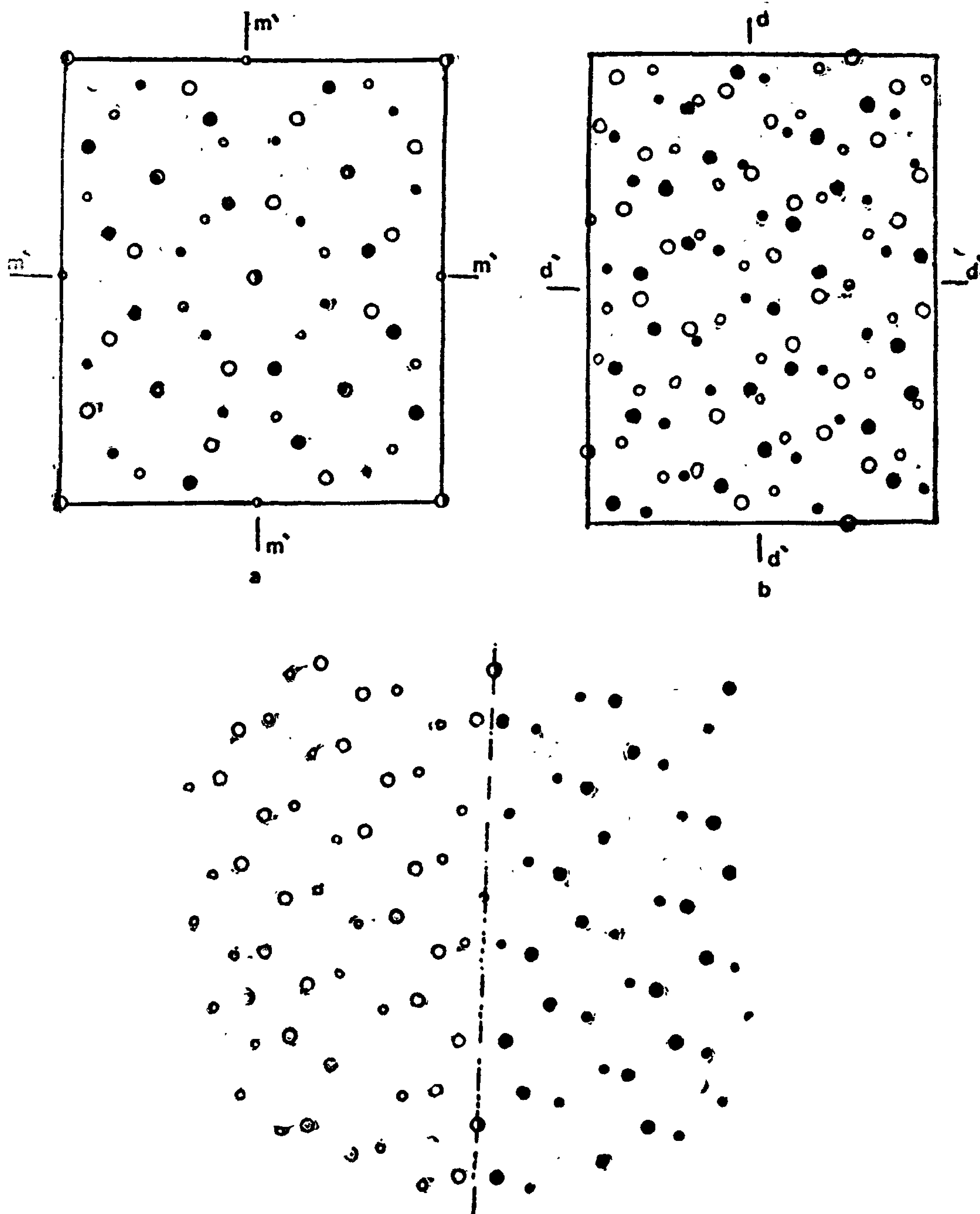


Fig. (2) Projection along [110] of
a- A model for the $\Sigma = 9$ boundary. The unit D is indicated.
b- A model for the $\Sigma = 3$ boundary. The unit A is indicated
c- A model for the $\Sigma = 27$ boundary. The unit G is indicated as well as D and A.

Fig. 1



Projection along [110] of

a-Dichromatic pattern formed by fcc lat-tices for $\Sigma = 27$

b- Dichromatic complex formed by dia-mond crystals $\Sigma = 27$

c- Ideal bicrystal formed from the dich-romatic complex.

The size of symbols represents the...ABABAB ... stacking along [110].

Although grain boundaries have two-dimensional features, it is useful to investigate three dimensional configurations of the interpenetrating point lattices 1 (black) and 2 (white). For convenience the lattices are view so that they have at least one point in common (which is called a coincidence site), and this was chosen to be the origin.

Let us imagine that we would like to determine the structure of a grain boundary, e.g., in the diamond structure where the reltative orientation of the crystals and the orientation of the boundary plane are given.

The first step is that the black lattice will rotate arround a common direction, in this case the [110] direction by 31.59° leaving the white lattice fixed. The formed pattern is called the dichromatic pattern. Fig. 1.a shows a dichromatic pattern formed for $\Sigma = 27$ [110]/31.59, the two lattices are fcc having the symmetry group Fm3m. The space group of the formed pattern is Fmm'm'.

The second step is to replace the point lattices by atoms to form the crystal structure, in this case the diamond structure will be obtained. The symmetry group of the diamond structure is Fd3m. The pattern formed in this case is called dichromatic complex which will have the space group Fdd'd', as shown in fig. 1.b.

The third stage leads to the geometric bicrystal by cutting the dichromatic complex through the boundary plane. This divides the space into two half-spaces, one of which is occupied by the white sites, and the other by the black sites. The symmetry resulting from this operation depends on the angle and position of the interface plane. Fig. 1.c shows a geometrical structure of $\Sigma = 27$ boundary.

The following particular points are worth specifying and commenting on; for each of the preceding stages, it is important to consider the operations that lead to maximal symmetry. A loss of symmetry element can give rise to the existance of variants which are related to each other by the lost symmetry operation. The dichromatic pattern and complex shown in the figures 1.a & 1.b, actually have the maximum symmetry group associated with the [011] rotation axis. Zheludev (10) stated that the point symmetry group of [011] direction is mmm in cubic crystals having the symmetry group m3m.

When the dichromatic complex is cut by the interface plane, only the symmetry elements that leave this interfacial plane invariant are preserved. Only an ordinary mirror perpendicular to the interfacial plane (552) is preserved (ordinary symetry elements are the symmetry elements that relate the same coloured points to each other i.e. black to black and white to white) independent to the interface position. For antisymmetry operations (which relate the different coloured lattice points i.e. black to white) only those which are contained in the interface plane remain undestoryed. The maximal symmetry of the geometrical bicrystal resulting from the cut is p2'mm' as can be seen from fig. 1.c.

Up till now, the bicrystal has been defined only from the crystallographic characteristics of the crystals adjacent to the boundary. The real bicrystal takes into account the relaxation processes (rigid body translations, migration of the interface plane, local atomic relaxation and insertion or removal of additional material at the interface) which can not be predicted from the crystallographic basic knowledge but are accessible experimentally. Experimental determination of the relative position of the adjacent for $\Sigma =$

STRUCTURE OF HIGH ORDER TWIN BOUNDARIES IN SILICON

Dr. A.M. Bastaweesy*

Abstract

The structure of $\Sigma = 27$ twin boundary in silicon has been studied using conventional transmission electron microscopy. The relative position of the adjacent crystals was determined by a special contrast technique.

A symmetric $\Sigma = 27$ boundary is found to be dissociated into facted $\Sigma = 3$ coherent and $\Sigma = 9$ boundaries. The structure of the boundary is complicated and α-fringes contrast technique can not be applied.

A crystallographic approach has been used to obtain the structure and the symmetry of $\Sigma = 27$ twin boundary in the diamond structure materials.

1 — Introduction

Twin boundaries in semiconducting elements which have diamond crystal structure have found a great deal of attention in the last few decades. These elements have widely used in intergrated circuits and solar cells, these boundaries can decrease the efficiency of these circuits and cells.

Rocher et al. (1) have showed that electrical activities of grain boundaries in silicon are different and depened on the structure of the boundary itself. They concluded that grain boundaries containing large density of extrinsic dislocations seem to have large electrical activity. While Bastaweesy (2), Vaudin et al. (3), Vlachavas and Pond (4), Fontain and Smith (5), have used T. E.M. to reveal the atomic structure of some twin boundaries in silicon.

Hornstra (6) was the first author to creat a model for the atomic structure of second and third order twin boundaries in diamond crystals. In his models., Hornstra tried to preserve the tetrahedral bonding where possible, thereby minimizing the number of broken bonds. Radial distribution functions of amorphous silicon show thot the Si-Si bonds vary in length by less than 1% from crystalline silicon, but that the bond angles can fluctuate by up to 15° as it was shown by Brodsky (7). Pond et al. (8) and Papon et al. (9), using this idea, have created models for $\Sigma = 3$, $\Sigma = 9$ and $\Sigma = 11$ boundaries showing no dangling bonds. In this work the same idea has been taken into consideration to construct a geometrical model for $\Sigma = 27$ showing also no dangling bonds.

2 — Crystallography and Symmetry.

Crystallography and symmetry of $\Sigma = 27$ (552) boundary in silicon will be considerd specifically. The theory of crystalline interfaces, needs, with known crystal structures, a knowledge of the values of at least five parameters, three for determining the relative orientation of the two crystal lattices (two angles for the orientation of the axis of rotation and one for the angle of rotation) and two parameters for determining the boundary plane.

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APPENDIX:

An example calculation is worked out to illustrate the sequence of selecting an apropriate WECS size. Assuming a rate of discharge of 1.16 1/sec (Daily yield of 100 m3) is pumped from boreholes at El-Qasr in the vicinity of M. Matruh against an overall pumping head of 40m. The overall pumping efficiency is estimated to be 60%.

Following the procedure mentioned above, it could be seen from Fig. 4-b, that for a capacity factor of 0.3, the rated power of the machine should be 2.5 kw. Refering to Fig. 3-c, WECS IV could be selected to meet the requirements without shortage allover the year. This machine has always surplus power reaching in some months about 50%. WECS V may also be used with less surplus power than the preceding one, but with defficiency in power required in months 9,10 and 11, If other machine types are available, e.g. WECS I, the rated power could be reduced to 1.8 kw. withouth defficiency (p/pr = 0.4). If the surplus power is thought to be large, the rated power has to be reduced, as the next WECS category is to be selected with the sacrifice of installing a back-up power supply to cover the shortage. In some cases one can accept a certain shortage specially when this occurs in the harvest season or other season with rainfall that can substitute the pumping process, all these conditions should be taken into consideration when selecting the system.

7. The horizontal and vertical lines from E and D respectively will met in F.

8. The line of will define the required rated power on the pr scale. Example calculations are given in the appendix.

CONCLUSIONS :

Water is supplied in the NW-coast through dug wells which has limited daily output between 1 and 5 m3 and from boreholes and collecting galleries of capacity around 100 m3/day. Each of these sources can be equipped with suitable WECS according to the wind characteristics at the site. The specifications of the WECS can be selected by the aid of the accompanied Nomograms and the capacity factor chart for each of the 4 mentioned sites along the coastal area from Sallum in the west to Alexandria in the east. Replacement of the existing wind pumping units with new well designed and sized ones is essential to avoid problems due to mismatching between the WECS and well specifications. The present method can be adopted wherever wind turbines are used in pumping water every where.

ABBREVIATIONS:*

c Weibull scale parameter, ms-1.

H Pumping head, m.

k Weibull shape parameter.

p Output power, W.

$\bar{p}$ Average power, W.

pr Rated power, W.

Q Rate of discharge, $m^3\ s^{-1}$.

$\bar{Q}$ Average rate of discharge, $m^3\ s^{-1}$.

v Wind speed, m s^{-1}.

vi Cut-in wind speed, m s^{-1}.

vo Cut off wind speed, m s^{-1}.

vr Rated wind speed, m s^{-1}.

η Efficiency, %.

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* Other appreviations, not frequently used, are explained in the text.

SELECTION OF SUITABLE WECS:

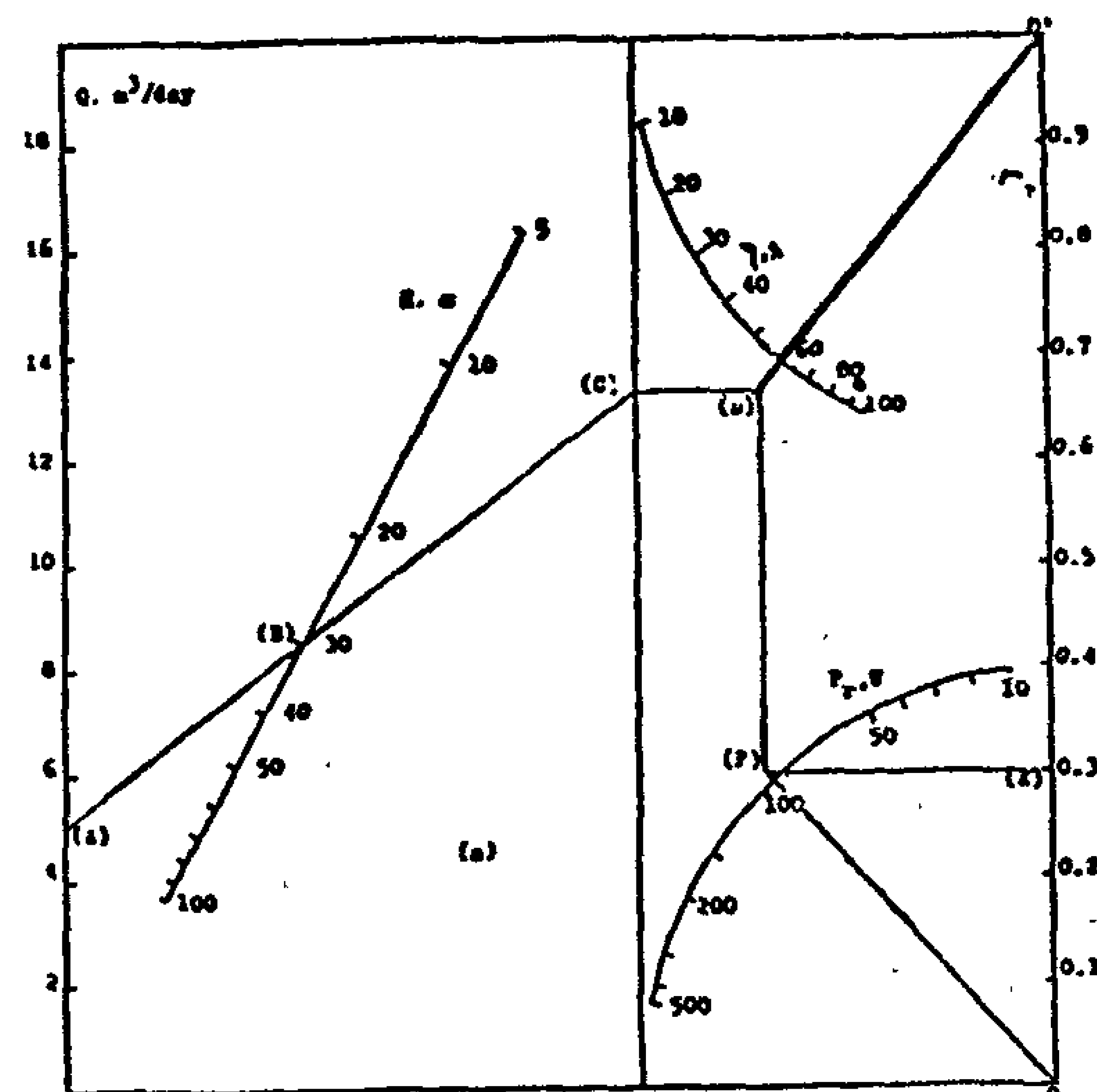
The selection of a WECS suitable for certain water requirement is a result of interaction of site and machine characteristics taking into consideration the characteristics of the water source mentioned above. To replace the existing pumping methods on the NW-coast, by a well sized WECS with defined specifications, a chart is constructed in the form of a Nomogram, Figs. 4 (a,b,), to facilitate the selection of the appropriate WECS. The variables represented on the Nomogram are the average water discharge rate Q, the overall pumping head H, the overall pumping efficiency , the rated power of the WECS and the capacity factor. To increase the accuracy of estimation, two Nomograms with different scales are submitted. The first one is suggested for low discharge rate and WECS with low rated power that can be used for dug wells with limited capacity, the second one for relatively higher rate of discharge that can be used for boreholes and collecting galleries.

The Nomograms can be used in conjunction with Fig. 3, in the following way:

1. Define a monthly average discharge rate needed to satisfy certain requirement based on monthly average values, point A on the far left scale, Fig. 4.

2. Define the overall pumping head of the system, point B.

3. Join A B and extend it to C.



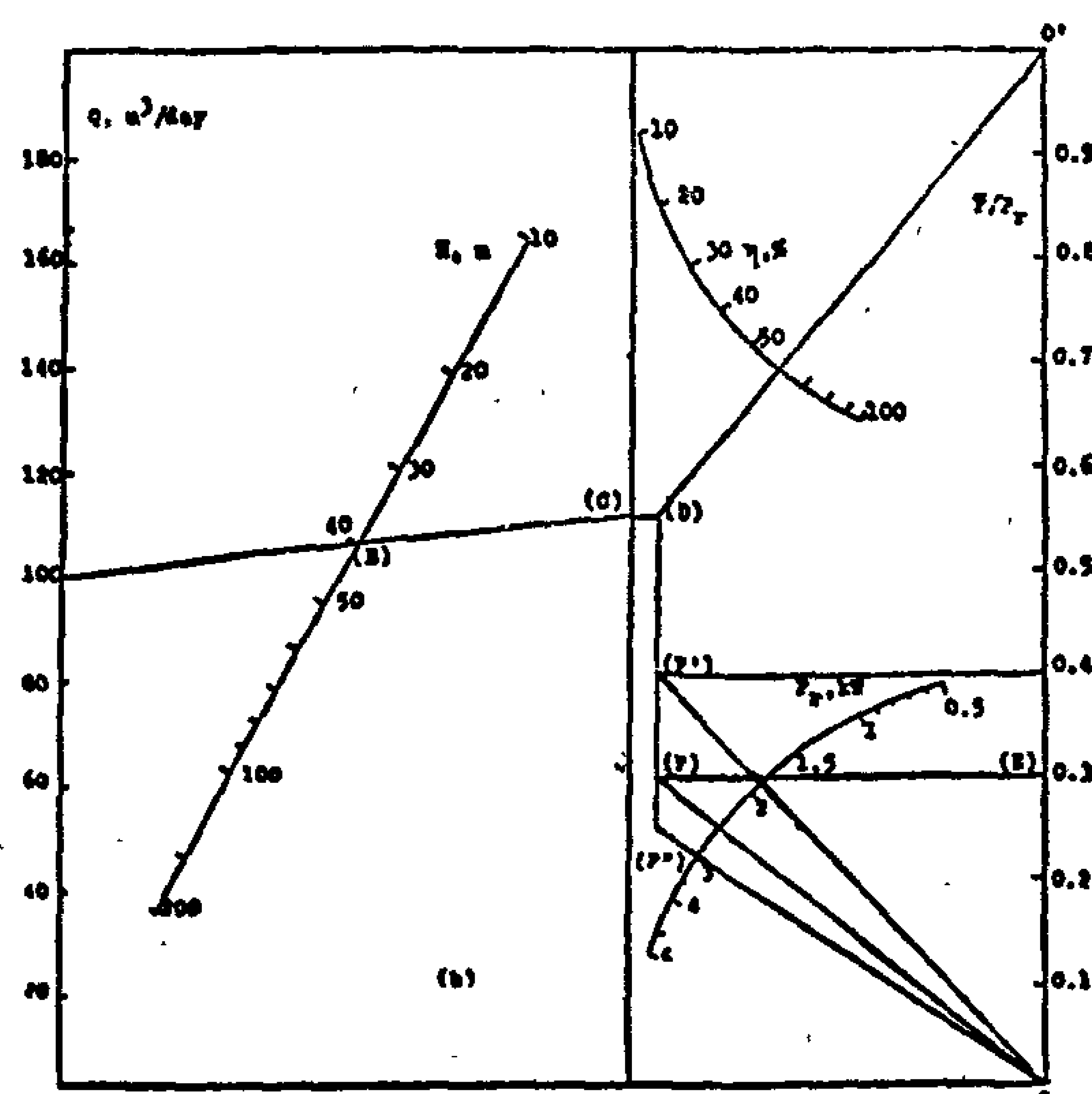
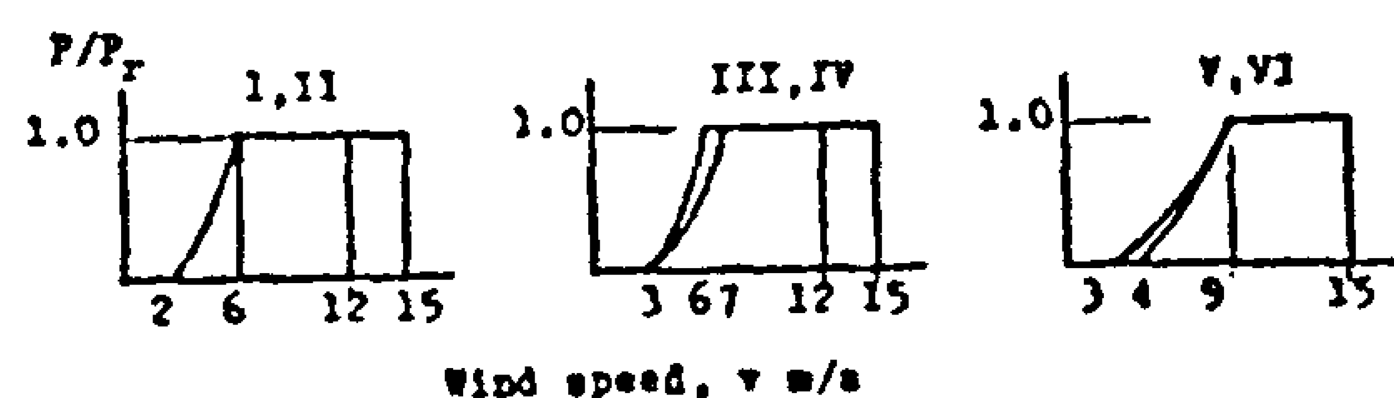


Fig. 4 (a,b) : A Nomogram for estimating the rated power of wind pumping systems.

4. Draw a ray from O representing the average overall efficiency of the system on the scale, a horizontal line from C meet this ray in D.

5. Drop a vertical line from D.

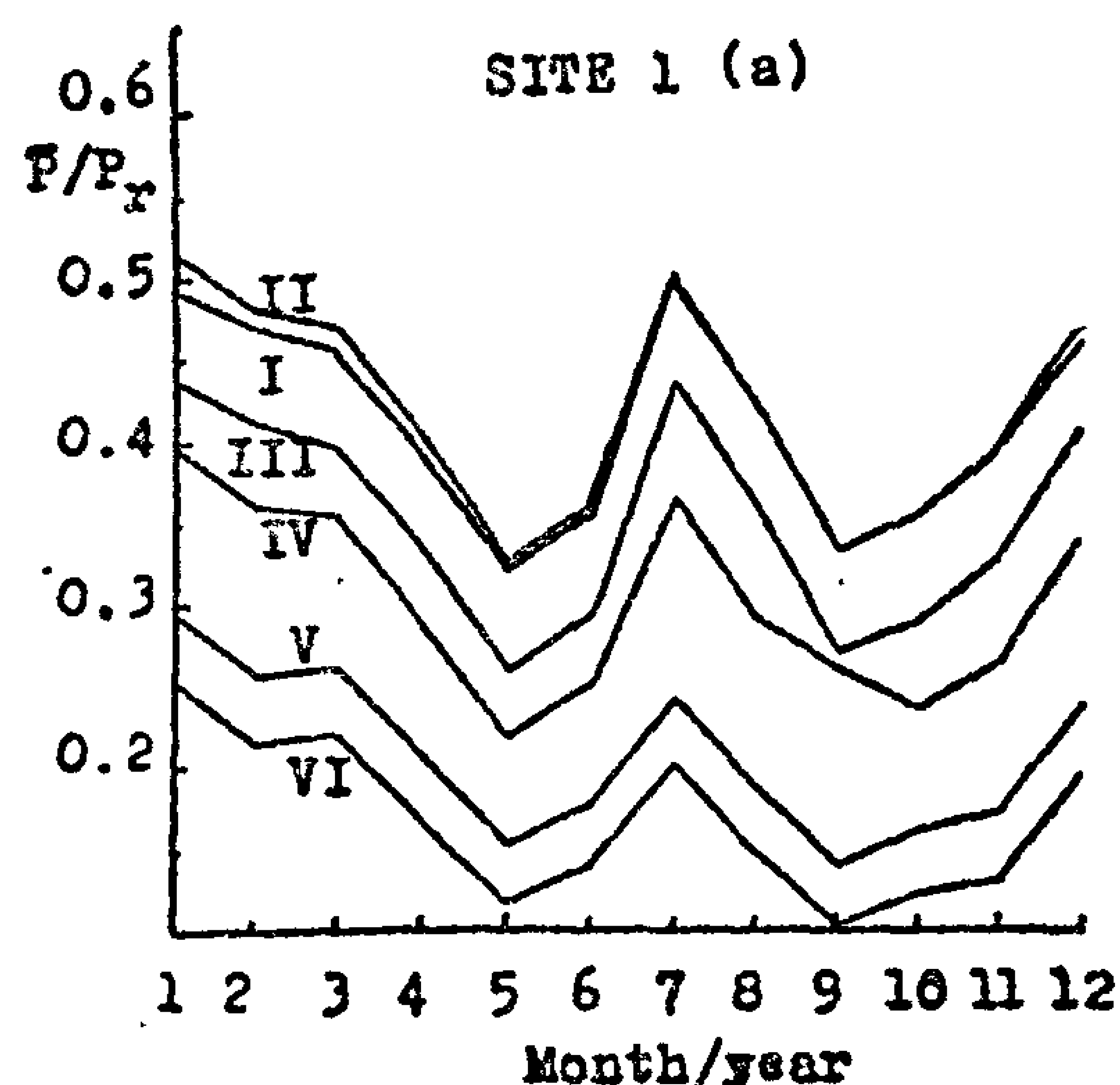
6. Draw a horizontal line represent the appropriate capacity factor of a suitable WECS categorie using Fig. 3., point E.

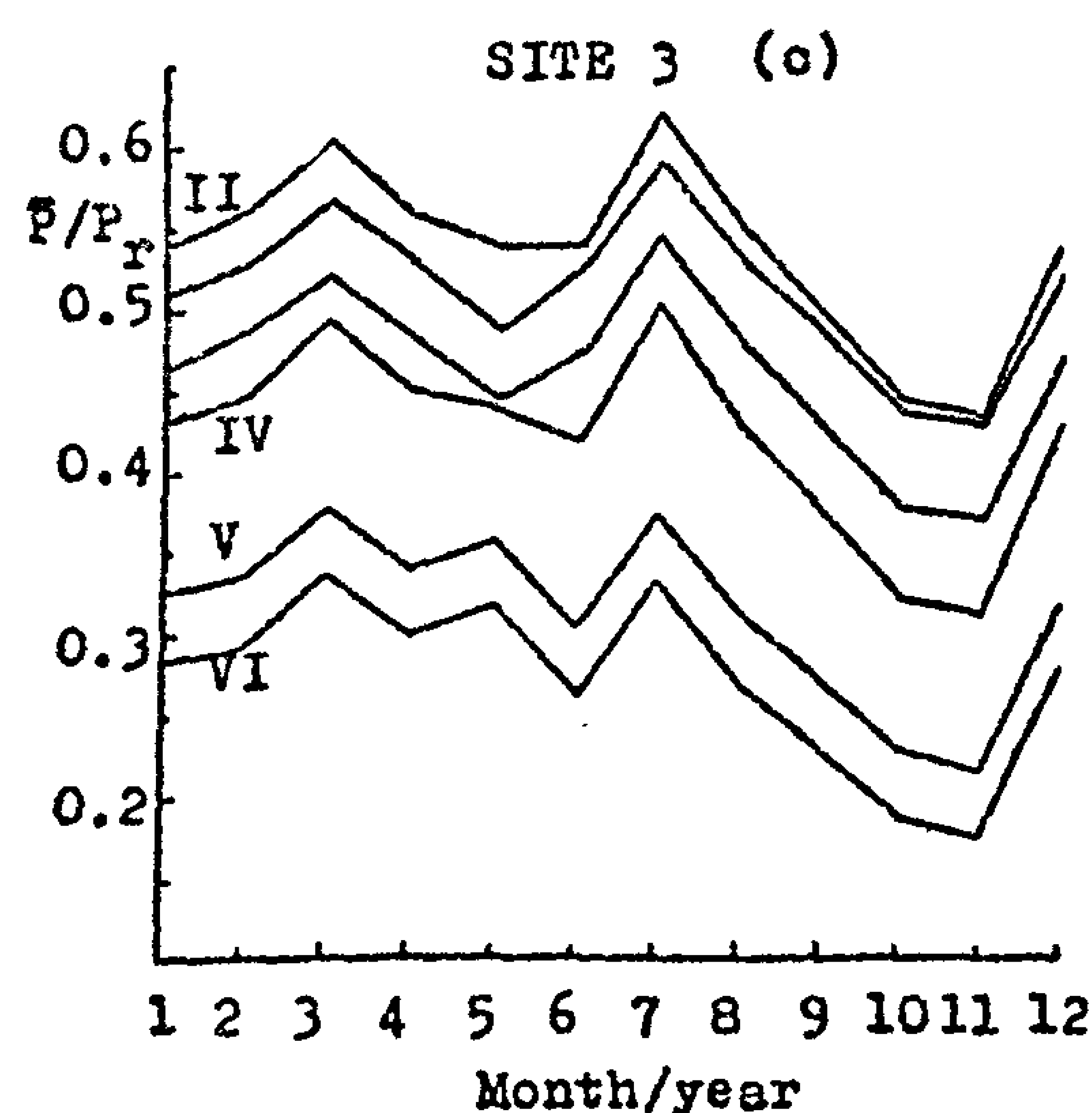


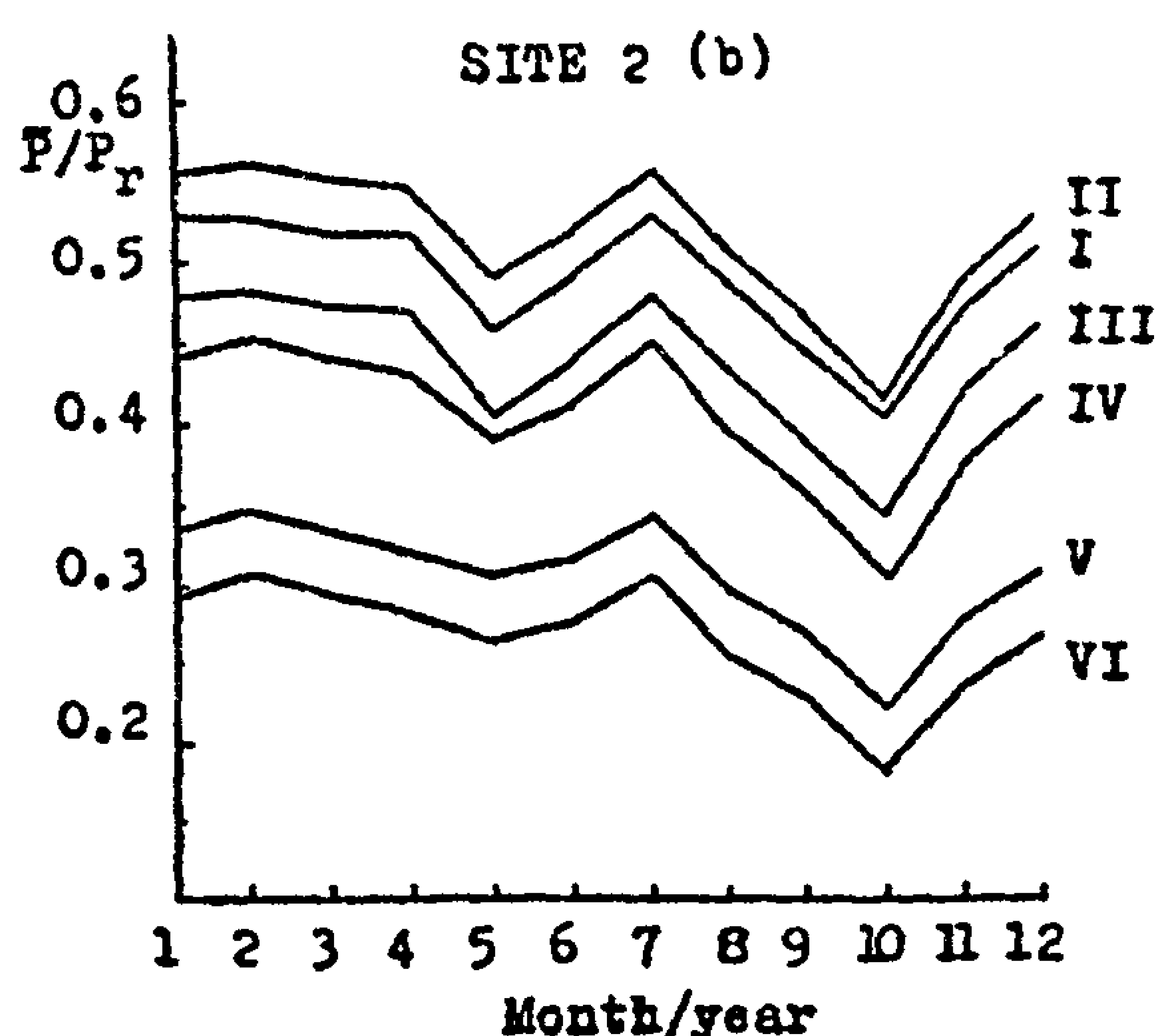
WECS No.	v_i	v_r	v_c
I	2	6	12
II	2	6	15
III	3	6	12
IV	3	7	15
V	3	9	15
VI	4	9	15

Fig.2: Comparison between different WECS characteristics.

to compute the capactiy factor p/pr for each WECS. The results are given in Figs. 3 (a-d). Te figures show that the capacity factor varies monthly depending on both site and machine characteristics. In some cases, e.g. for site 1, systems I and II have almost identical values despite of the difference in vo. This phenomena is particular to that site and can be attributed to the fact that the average wind speed is relatively low. As the cut-in wind speed decreases, the capacity factor increases, see systems V and VI. It is further increased by using WECS with low rated wind speed for all sites.







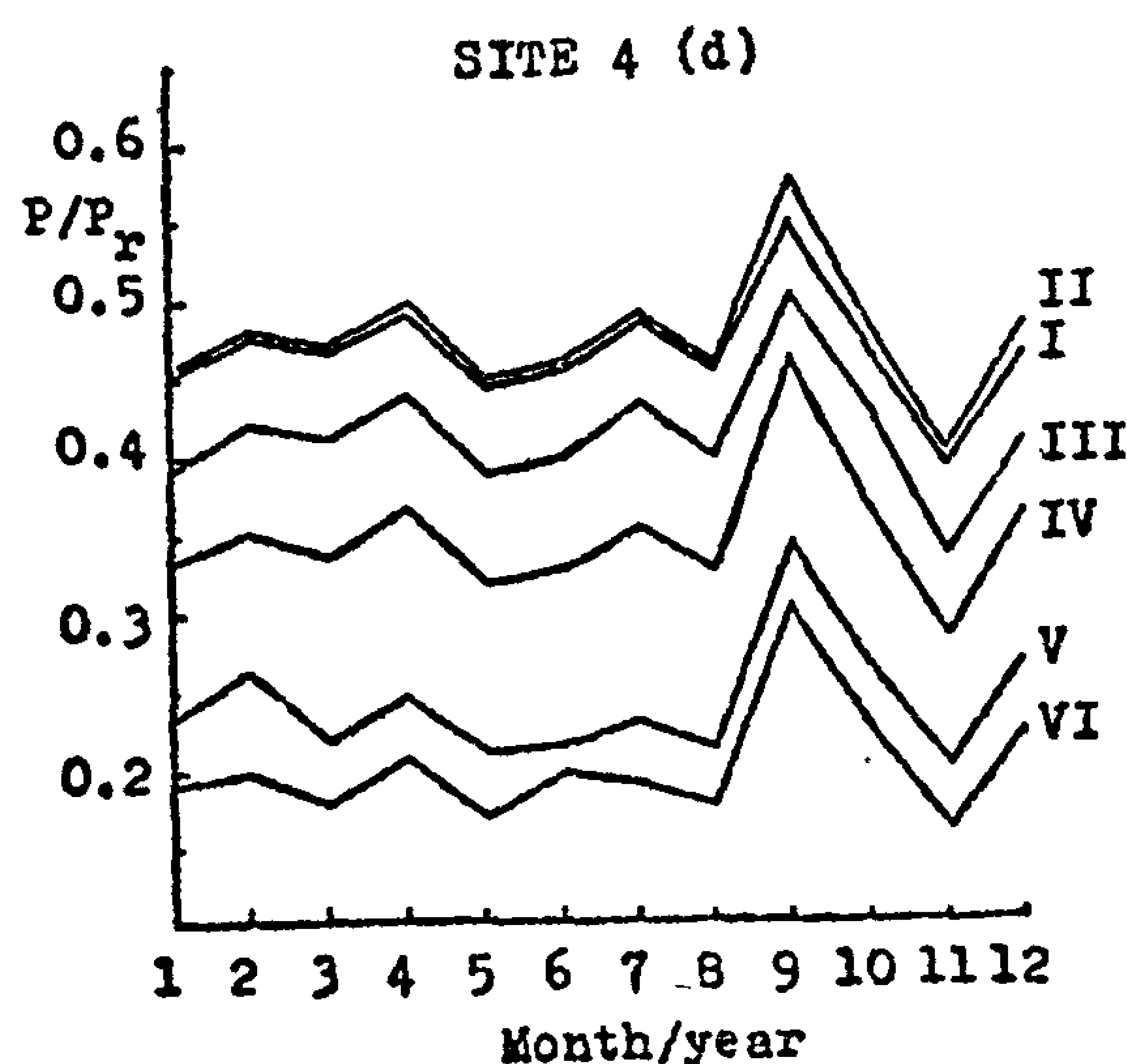


Fig. 3 : Monthly capacity factor of different Sites and WECSs.

Site 1 Sallum, Site 2 : Mersa Matruh, Site 3 : Dabaa, Site 4 : Dekhiela

vr to a cut-off wind speed vo. Practical solutions of the partial power range were discussed in [12] by considering quadratic and exponential relations as follows:

$$p\,(v)_{v_i - v_r} = A + Bv + Cv^2, \text{ or} \quad (2)$$

$$p\,(v)_{v_i - v_r} = a + b\,v^k \quad (3)$$

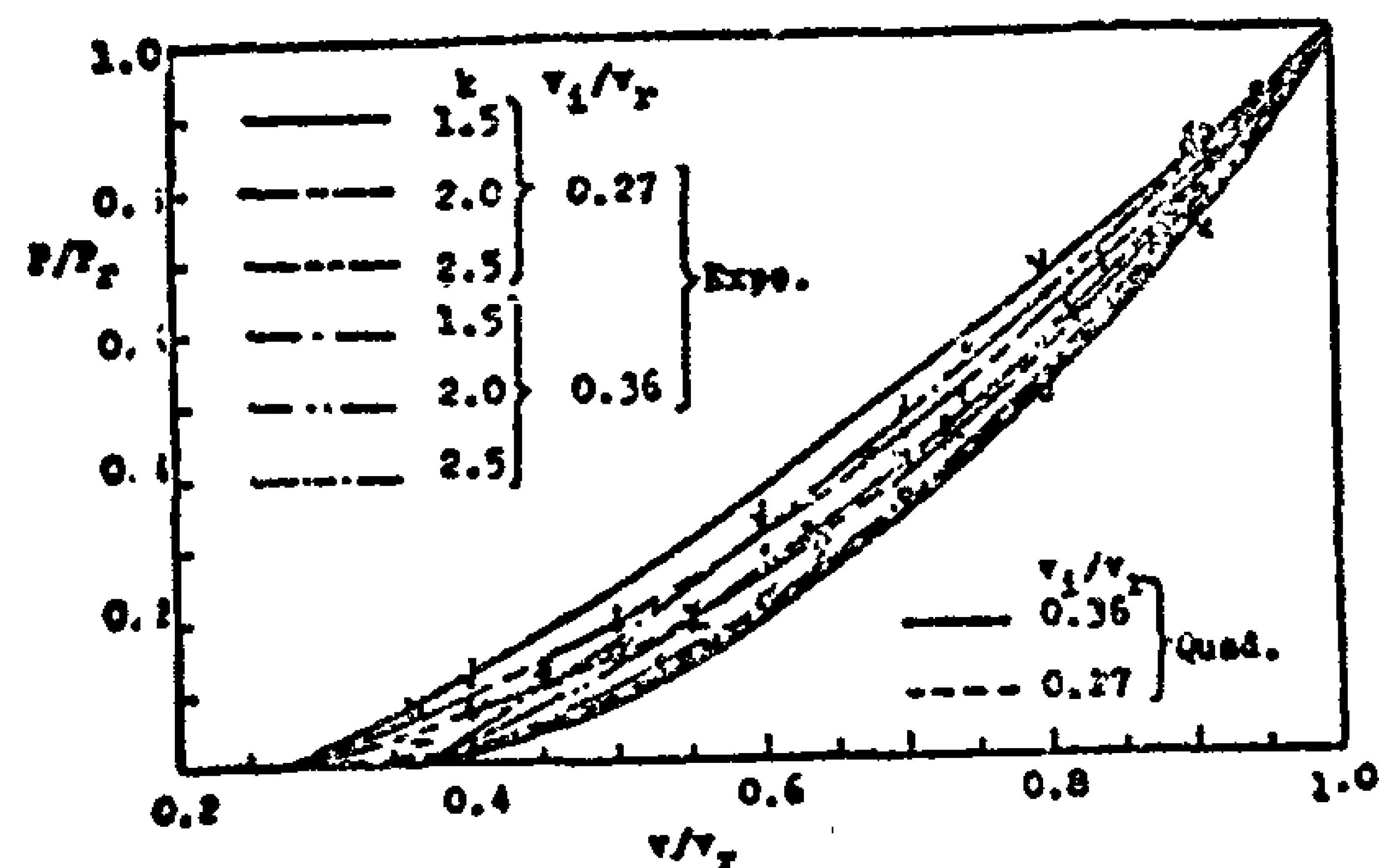
where:

A,B,C,a and b are constants and could be evaluated using WECS characteristics, and k is the Weibull shape parameter.

A comparison between the two formulas is carried out using the actual data given by manufacturers* of 10 different machines, as shown in Fig. 1, using v/vr as abscissa and p/pr as ordinate. Both relations are drawn for vi/vr = 0.27 and 0.36. These values represent the lower and higher limits of the checked machines. The exponential formula is further computed for 3 different k-values (1.5, 2.0 and 2.5). The figure shows that the quadratic relation mostly underestimates the output, and insensitive to the variation of the cut-in wind speed. On the contrary, the exponential relationship is more realistic except in the case where k is less than 1.5. It is found that the majority of the k-values for the above mentioned sites lie between 1.6 and 2.2, hence the exponential relationship is found more practical and will be used for further calculations.

Type	P_r	v_i/v_r
Cencenbaugh	0.5	0.36
"	1.0	0.33
Winco	1.1	0.35
"	0.9	0.35
"	1.3	0.30
"	2.5	0.27
Jacobs	20.0	0.32
Elektro	10.0	0.27
"	6.0	0.30
Enertech	40.0	0.31

* Different manufacturers brochures.



Fgi. 1 : Comparison between actual power output and calculated output of different wind turbines.

The average power output, $\bar{p}$ of the WECS in the whole range from vi to vo will be given by:

$$\bar{p} = \int_{v_i}^{v_o} f(v)\, p(v)\, dv$$

where :

f(v) is the PDF of the wind speed at the site for the interested period of time given by Eq. 1, p(v) is the output power as given by Eq. 3 for $v_i < v < v_r$ and p(v) = pr for $v_r < v < v_o$. Equation 4 is computed for 6 differnt categories of WECS assumed to be used under wind conditions of the 4 sites. The characteristics of these machines are given in Fig. 2, which are based on manufacturers data, [13], and some practical experience. It is noticed that WECS I and II differ from each other in vo, systems III and IV vary in vi and vr, whereas systems V and VI have different vi only.

The data of the monthly PDFs of the 4 sites (k & c values) and the characteristics of the WECSs are used in Eq. 4

by different ways, such as dykes, cisterns, dug and drilled wells, and collected galleries [2].

Cisterns, dated back to the Roman period, have been excavated in the rock and their capacity varies from 100 to 1000m3. Most of them are silted up. In 1979, 2200 cisterns have been excavated to provide 356800m3 of water. The power needed to drive water 500m far from cistern at a pressure head of 4 at is estimated to be 2 to 5 hp. [3].

Beside cisterns, there are approximately 1500 dug well equipped with windmills. About two thirds of these wells are in Burg El-Arab, Dabaa, M. Matruh and Sidi-Baranni [2]. About 30% of them are still in use [4]. The dug wells are ranging from 1 m to 4 m in diameter and the depth of water varies from few meters to more than 30 m [4]. The average rate of discharge per wind mill varies between 1 and 5 m3/day.

Drilled wells are found in some places on the coast. The wells at Fuka (near El Dabaa) are capable of producing 20m3/hr for 5 hours daily using electric driven pumps rated at 5 hp [2].

The most extensive gallery development is at El-Qasr (M. Matruh), where there are 10 collecting galleries with a total length of 11.5km. The estimated output of the galleries is found to be 0.056-0.071 m3 per meter length of the gallery per day. This water is used for irrigation far from the galleries using diesel driven pumps of 6-12 hp. The daily discharge of a pumping unit installed on the gallery ranges between 60 and 120 m3/day.

WIND RESOURCES:

The annual average wind speeds along the NW-coast fluctuates between 4 and 5.5 m/s, [5]. These values are confirmed by recent measurements given in [6]. The data obtained from [5] was tabulated, processed and analyzed in [7, 8 and 9]. Suitable probability density functions, PDF, can also be used to describe the speed distribution mathematically[10]. The favourable PDF that can be used is the Weibull distribution which takes the form:

$$f(v) = \frac{k}{c}\left(\frac{v}{c}\right)^{k-1} \exp.\left[-\left(\frac{v}{c}\right)^{k}\right] \quad (1)$$

where:

f(v) is the wind speed Weibull distribution function, k is the shape parameter and c is the scale parameter. The data given in (5) has been fitted to the appropriate Weibull PDF in [11 and 12]. The method of linear regression mentioned in [12] is adopted in the present work to compute the Weibull parameters k and c for each of the four meteorological stations along the coast (1-Sallum, 2-Mersa Matruh, 3-Dabaa, and 4-Dekheila), month by month at a reference height of 10m above the ground level. The computed results are used to estimate the power output of wind turbines installed at these sites.

AVERAGE POWER OF A WECS:

The power output of a WECS is generally devided into two parts. The first part begins from a cut-in wind speed vi to a rated wind speed vr. The second part is the rated power range and begines from

WATER YIELD FROM WIND PUMPS FOR DESERT DEVELOPMENT IN EGYPT

A. El-Mallah and A.M. Soltan

A procedure is presented to select appropriate wind turbines for water pumping on the North Western coast in Egypt. Therefore, wind speed data for different locations have been collected and classified and then fitted to Weibull probability distribution function. The fitted data was corrected to the standard 10-m anemometer height. A survey of the water resources on the coastal area is also presented where the wells are classified with respect to water depth and safe withdrawal rate of discharge. The mathematical formulas are established and a Nomogram is constructed to help in easy selection of the candidate wind turbine. A comparison of the performance of six machines with different characteristics is given for each of the sites. Practical examples are given to show how to replace existing pumping methods, by suitable wind pumping systems.

INTRODUCTION:

Water is necessary for desert development, to settlement of nomadic population and to help in creating new communities. The North-Western coast, NWC-coast, is one of the attractive regions that find large interest at present. The coastal zone from Sallum to Alexandria possesses both water and wind resources, which make it possible to use wind energy for pumping water.

Local water resources originate mainly from rainfall which feed the underground water through sheet run-off, [1,2,3 &4]. The present underground water supply is delivered by electric and diesel driven pumps from boreholes or galleries. Small size wind pumping units were installed in the early sixtieth along the NWC-coast to pump water for irrigation. About 1500 dug wells were equipped with such machines. Most of these with pumpers are run down due to lack of maintenance and repair. Some of the owners suffered from insufficient water supply and others complained from excessive pumping which exceeds the safe withdrawal rate of the well which led to deterioration of water quality and silt-up the wells very fast.

Moreover the introduction of electricity and Nile water through canals and piping systems replaced the wind turbines by electric and diesel driven pumps.

Although all the wind pumping units are running now above its expected life time, some of them are still in good condition and working very efficient. Then, it is fruitfull to replace the ruin of the old machines by new, resized and well designed Wind Energy Conversion systems, WECS, for pumping water taking into account the water needs, the safe withdrawal of the water sources and the wind characteristics of the site. The method adopted in the present work is suggested to help in selecting the appropriate WECS for the different locations with emphasis to the NWC-coast.

SURFACS AND UNDERGROUND WATER RESOURCES :

The surface and underground water for drinking and irrigation could be obtained

* Assoc. Profs., Mech. Eng. Lab., National Research Center.

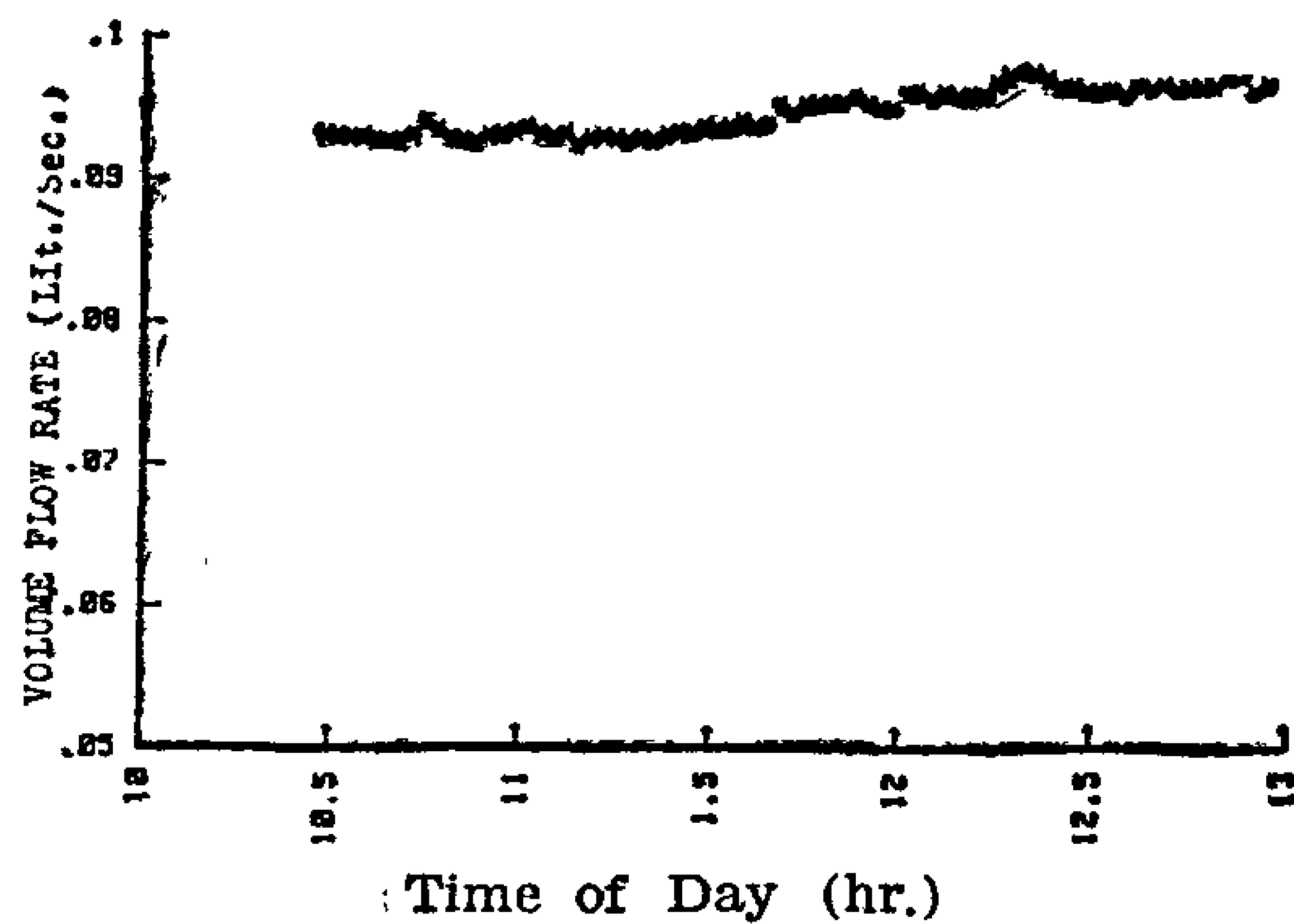


Fig. (15) Volume Flow Rate Through a Collector Array.

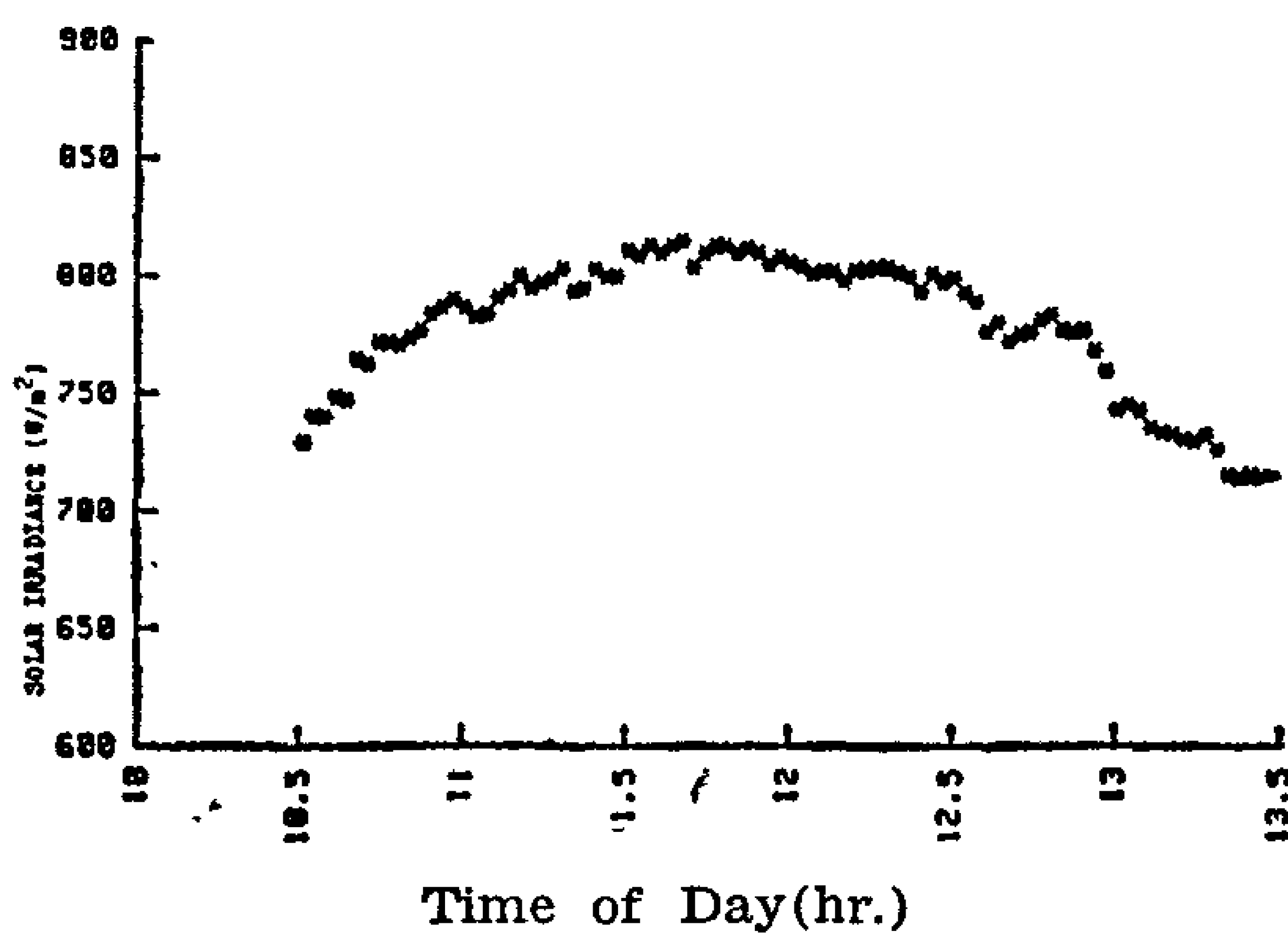


Fig. (16) Solar Insolation on a Collector Surface (5/5/1987)

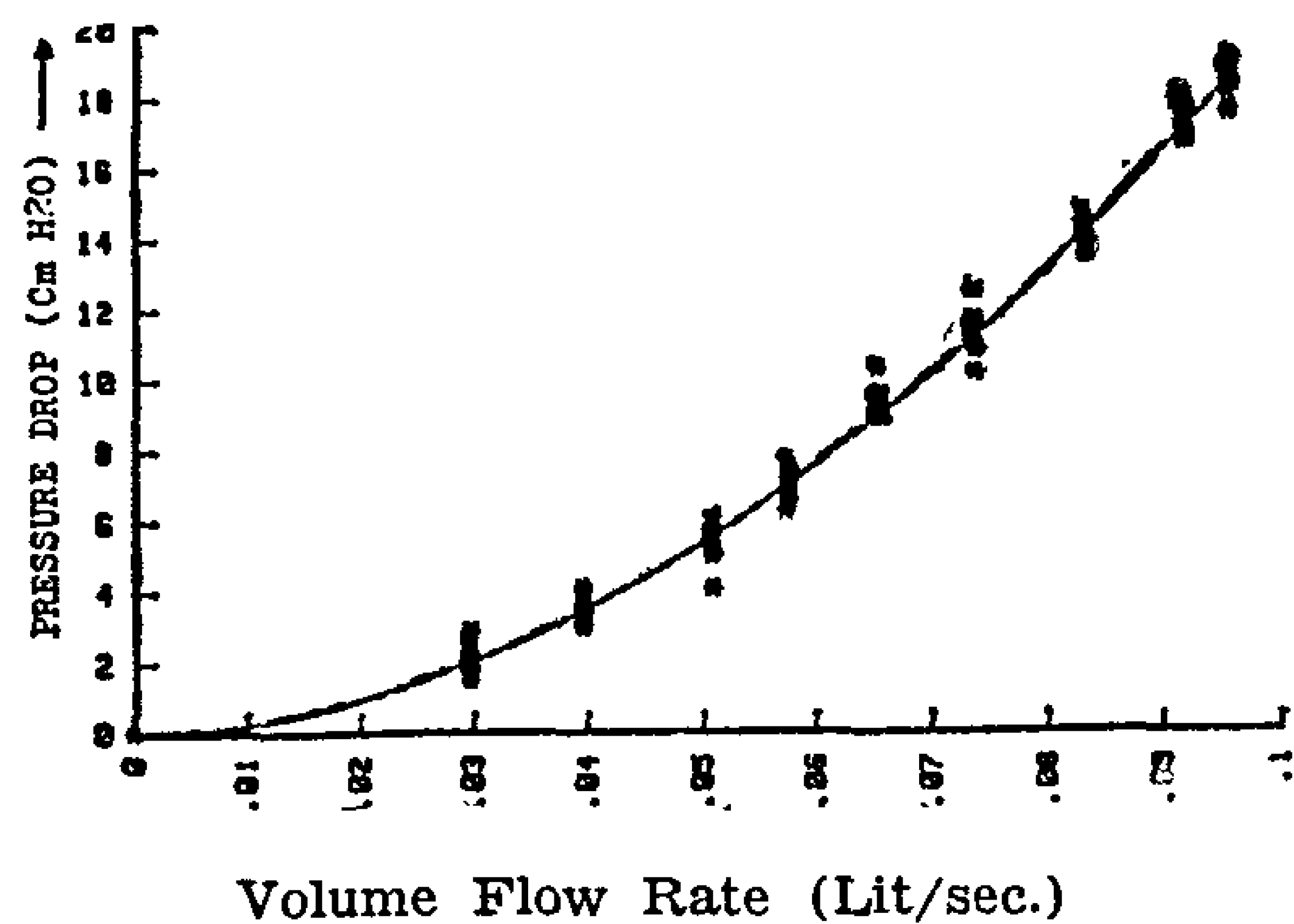


Fig. (17) Pressure Drop in a Solar Collector Array.

7. CONCLUSIONS

(1) An outdoor testing facility has been established at the faculty of engineering, Ain Shams University.

(2) The facility is provided with a microprocessor based data acquisition and measurements system.

(3) The system is provided with the sensors and transducers required to monitor the performance of solar heating systems.

(4) The paper presents a detailed description of the transducers, their response, and interfacing terhniques.

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5. SAMPLE OF METREOLOGICAL MEASUREMENTS

Figures (10), (11), (12) and (13) show the variation of solar insolation on horizontal surface, ambient temperature, wind speed and direction as measured on the 15th of August 1987.

6. SAMPLE OF SOLAR WATER HEATING SYSTEM PERFORMANCE

Figures (14), (15) and (16) show the variation of collector inlet temperature, outlet temperature, mass flow rate, and solar insolation incident on the plane of the collector for a water heating system over a period of 3 hours as recorded by the measurements system. Figure (17) also shows the measured pressure drop through the system against the volume flow rate.

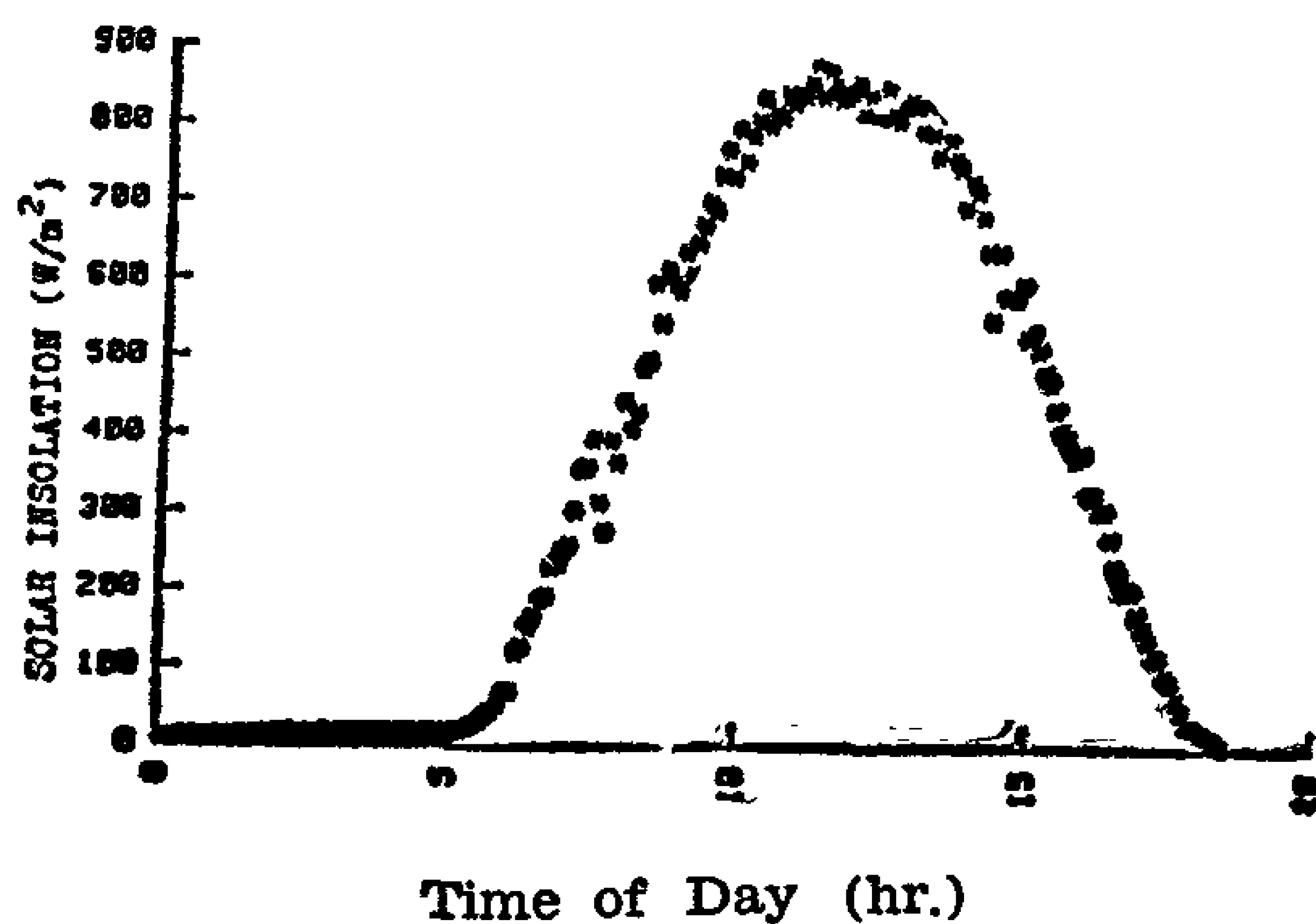


Fig. (10) Solar Insolation on Horizontal Surface, 15th August 87

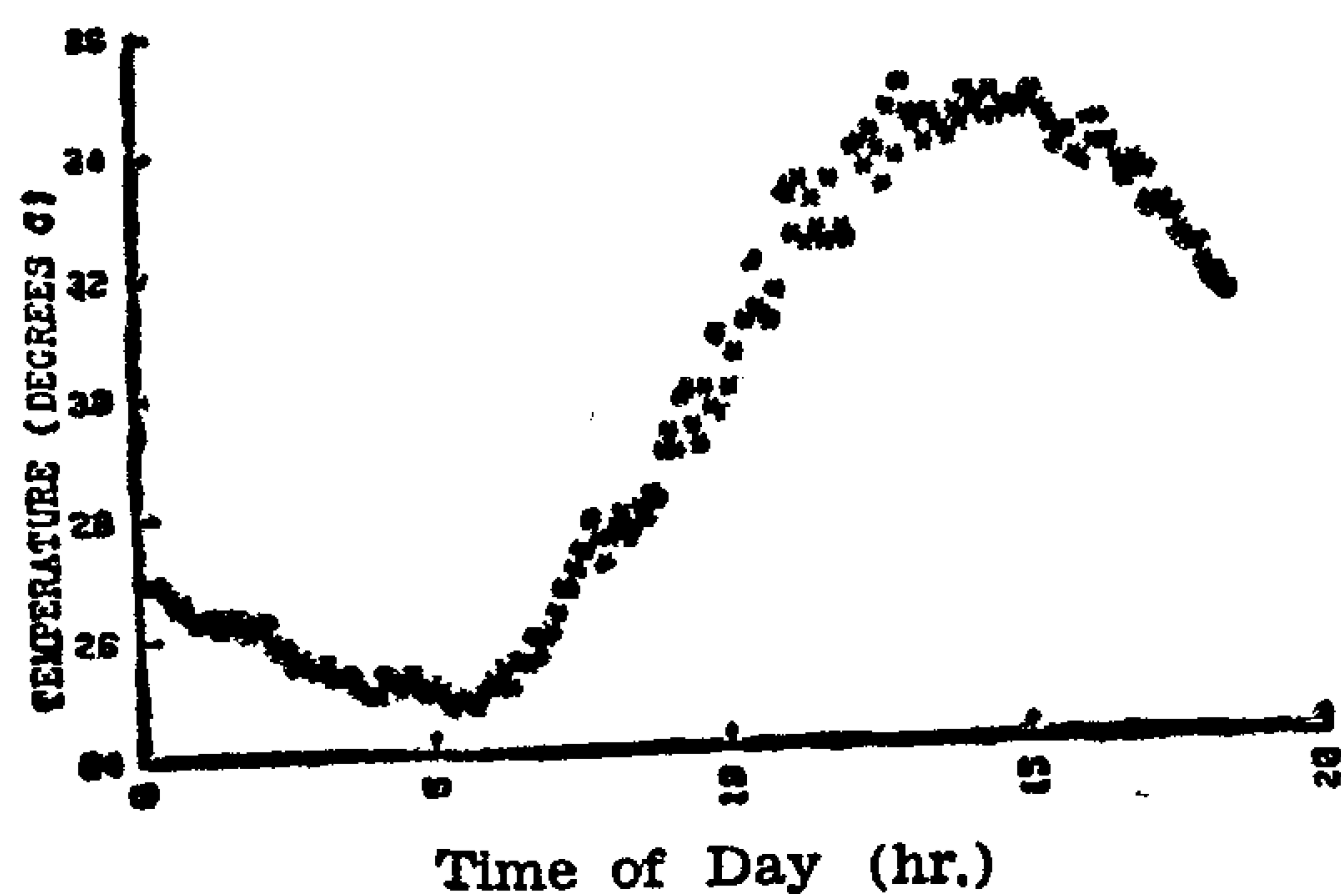


Fig. (11) Ambient Air Temperature, 15th Aug. 87.

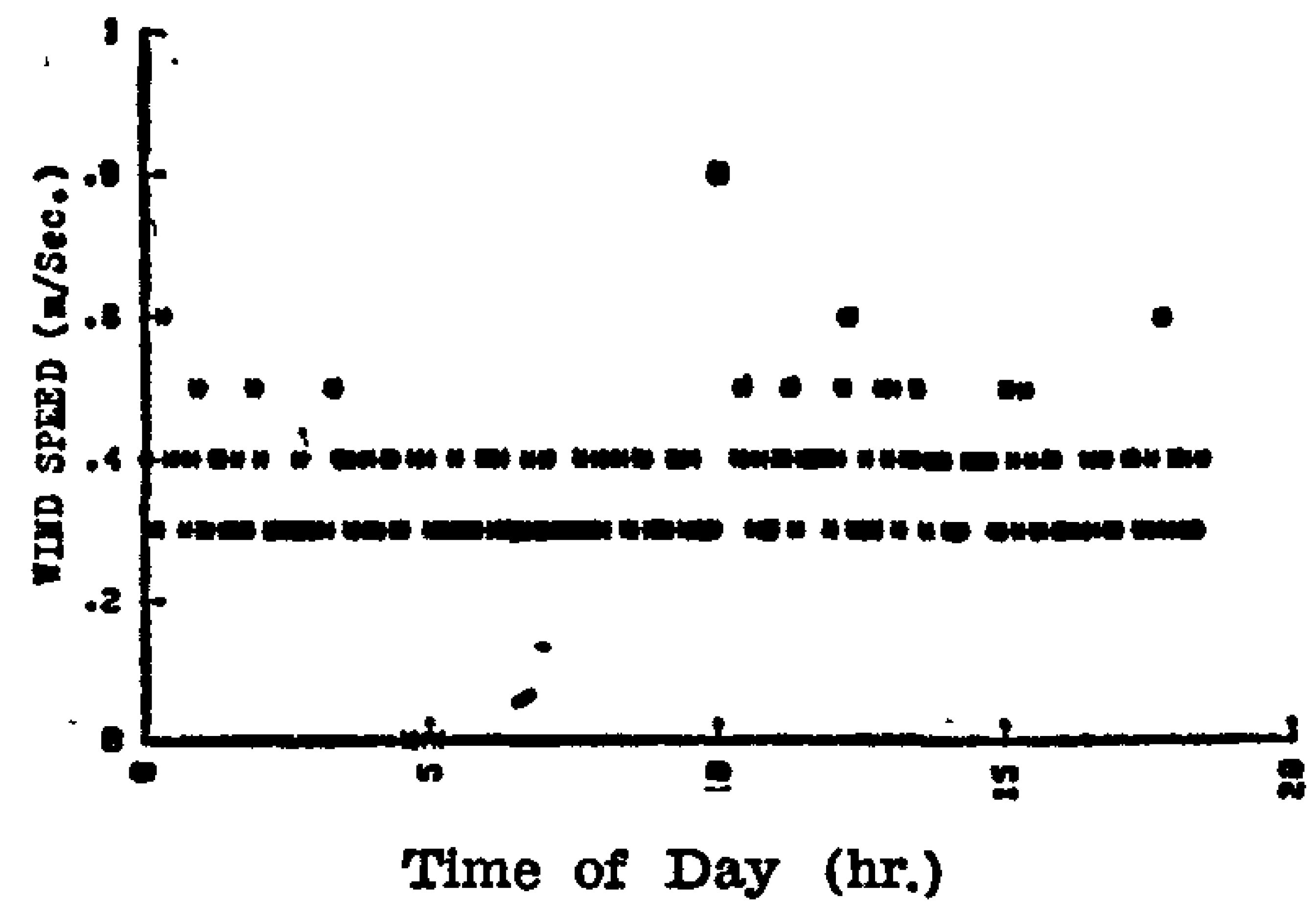


Fig. (12) Wind Speed, 15th of Aug. 87

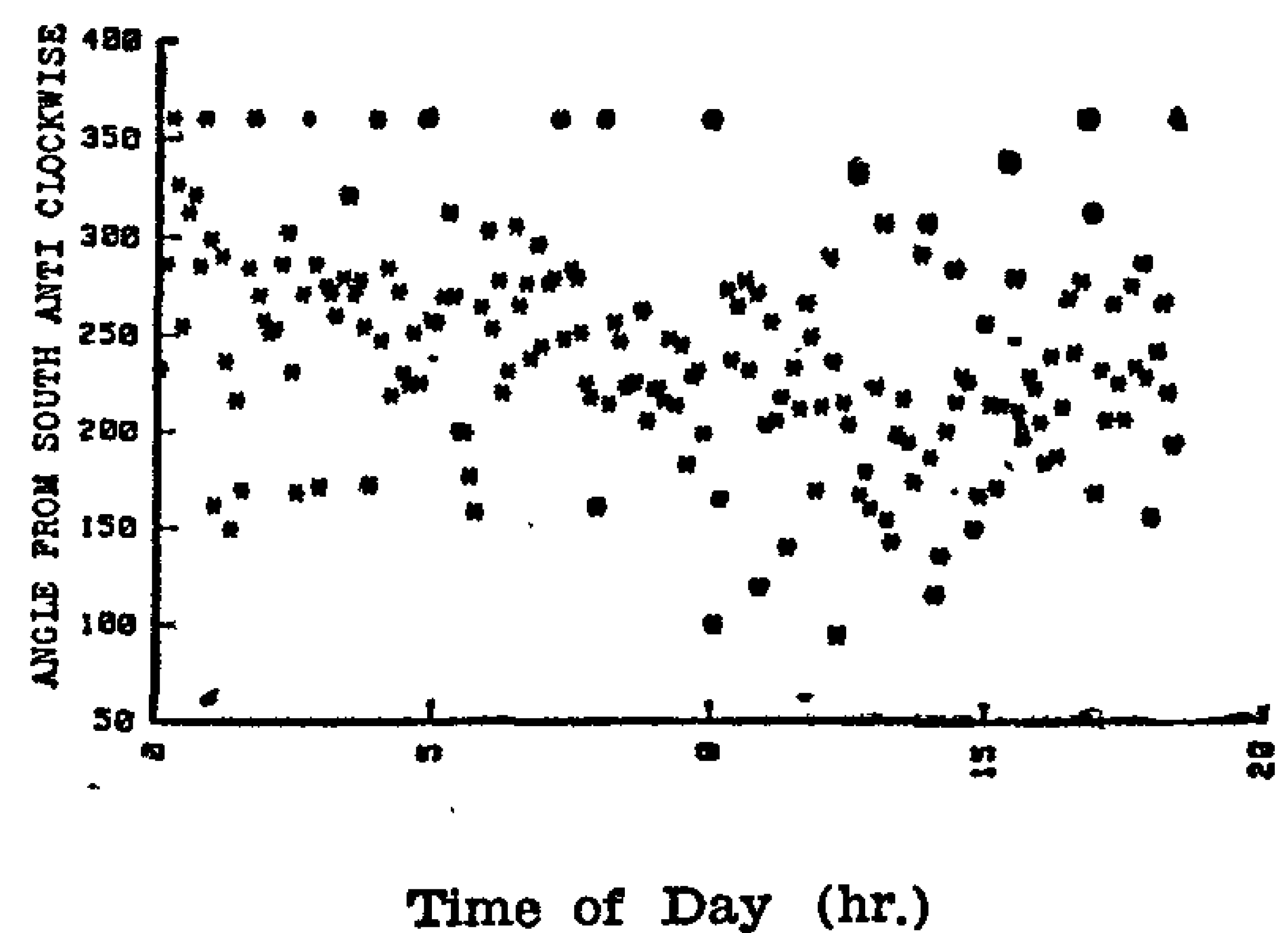


Fig. (13) Wind Direction, 15th of Aug.

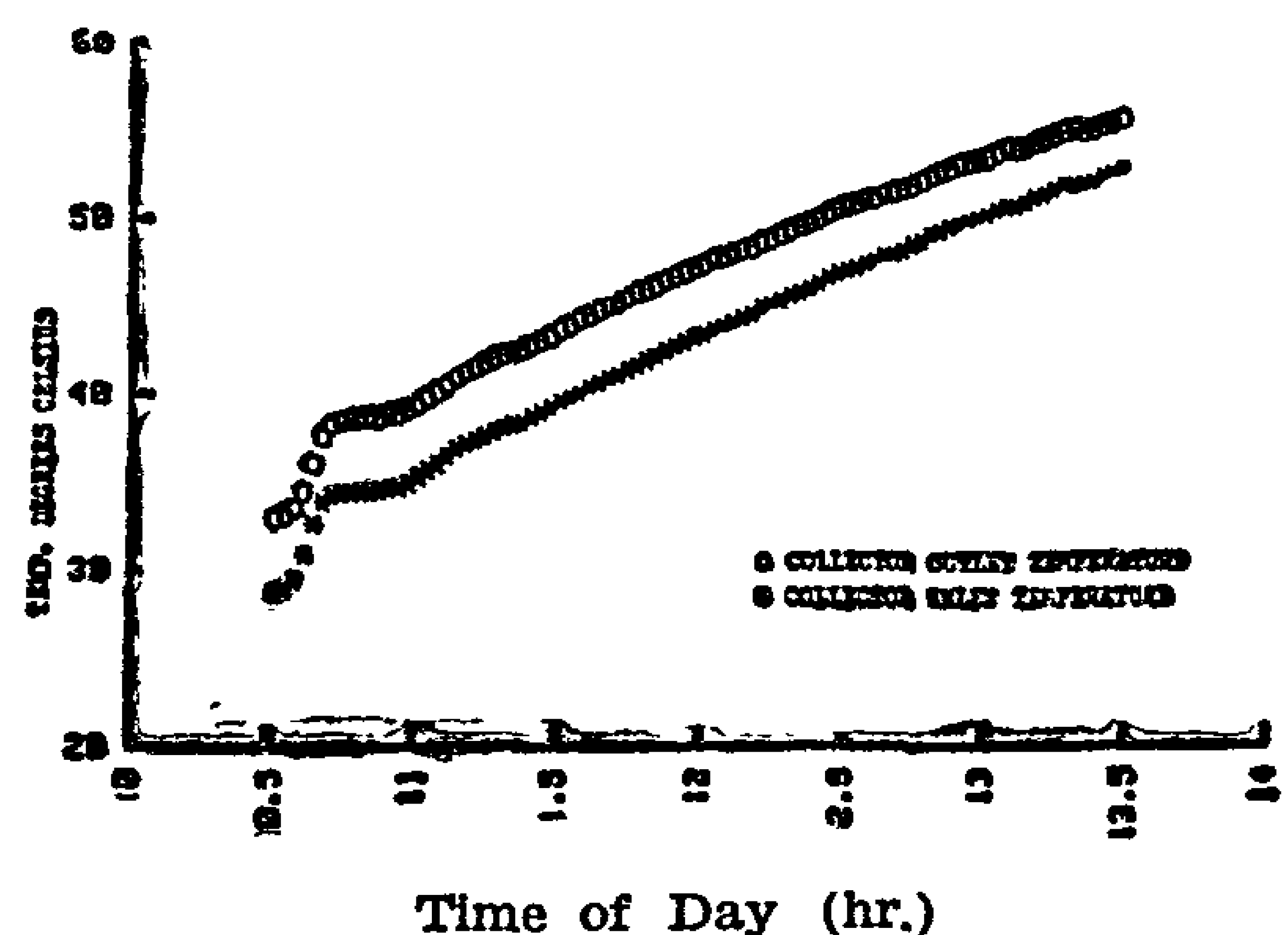


Fig. (14) Variation of Col. Inlet and Outlet Temperature with Time.

from the cup anemometer as recorded by an X-Y plotter for different wind speeds. It can be seen from the figure that frequency rather than amplitude specially at fairly low speeds gives a more accurate representation of the speed. This is due to the fact that frequency is directly linked to the speed of rotation of the anemometer cups. Calibration results are included in the measurements system software.

4.6. Wind Dirrection

Type of transducer: Wind direction is measured by means of a vane rotating around its vertical axis. The vane has a fin attached to its trailing edge so that the pointer, leading edge, always points towards wind direction. The vane is placed on top of a potentiometer which rotates concentrically with the vane.

Interfacing the transducer to the data acquistion unit: The transducer is interfaced to the data acquisition unit by conneting the red and orange terminals to one of the channels of the relay multiplexer assembly and measuring the resistance between them.

Measurement technique: An output signal is obtained from the transducer through the potentiometer. The potentiometer has three wire terminals; red, brown and orange. The resistance between the red and orange terminals is constant, 250 ohms, while the resistances between the orange and red terminals and the orange and brown terminals, R1 and R2, are dependent on the position of the wind direction vane.

In the present set up, the position of the wind direction vane is adjusted so that when the pointer points towards the south the red and orange terminals coincide.

Measurements of wind direction is achieved by measuring the resistance between the red and orange terminals as follows:

(1) When R1 reads 0 or 520 ohms, wind direction is due south.

(2) When R1 lies between 0 and 520 ohms, in this case wind direction makes an angle equals R1 x 360/520 degrees measured anticlockwise from south.

4.7. Pressure Drop

Type of sensor: A differential pressure transducer is used to measure the pressure drop either through collectors or systems. The transducer is a differential pressure transmitter which gives an output signal from 4 to 20 mamp. depending on the applied differential pressure. The measuring element houses a membrane which is displaced with the applied differential pressure. An inductive displacement pick up converts the membrane displacement to an electrical signal. The measuring range can be adjusted between 40 and 200 mbar. A power supply is needed to energize the transmitter. The supply voltage depends on the resistance of the leads connecting the transmitter to the data acquisition unit.

Interfacing the transducer to the data acquisition unit. In the present set up, a high precision resistor of 250 ohms is connected in parallel to the transmitter. The resistor is connected to the 20 channel relay multiplexer assembly. Thus the output voltage would therefore vary between 5 V and 1 V depending on the applied differential pressure.

Calibration of the transducer : Calibration of the transducer is carried out by adjusting the zero balance of the transmitter to correspond with 4 mamp. The span of the transmitter is determined by applying a differential water head corresponding to the required span and adjusting the span potentiometer.

Pyranometer Sensitivity	11.12x10^{-6} volt/watt. m2
Spectral Range	... **0.3 um to 3 um**
Linearity	± 1%
Temperature Compensation	± 1.5% from - 20 C to + 40 C
Cosine Response	± 2% from 0 to 70 degrees

The time constant of the pyranometer was determined at the laboratory by measuring the pyranometer response after a step change as shown in figure (8).

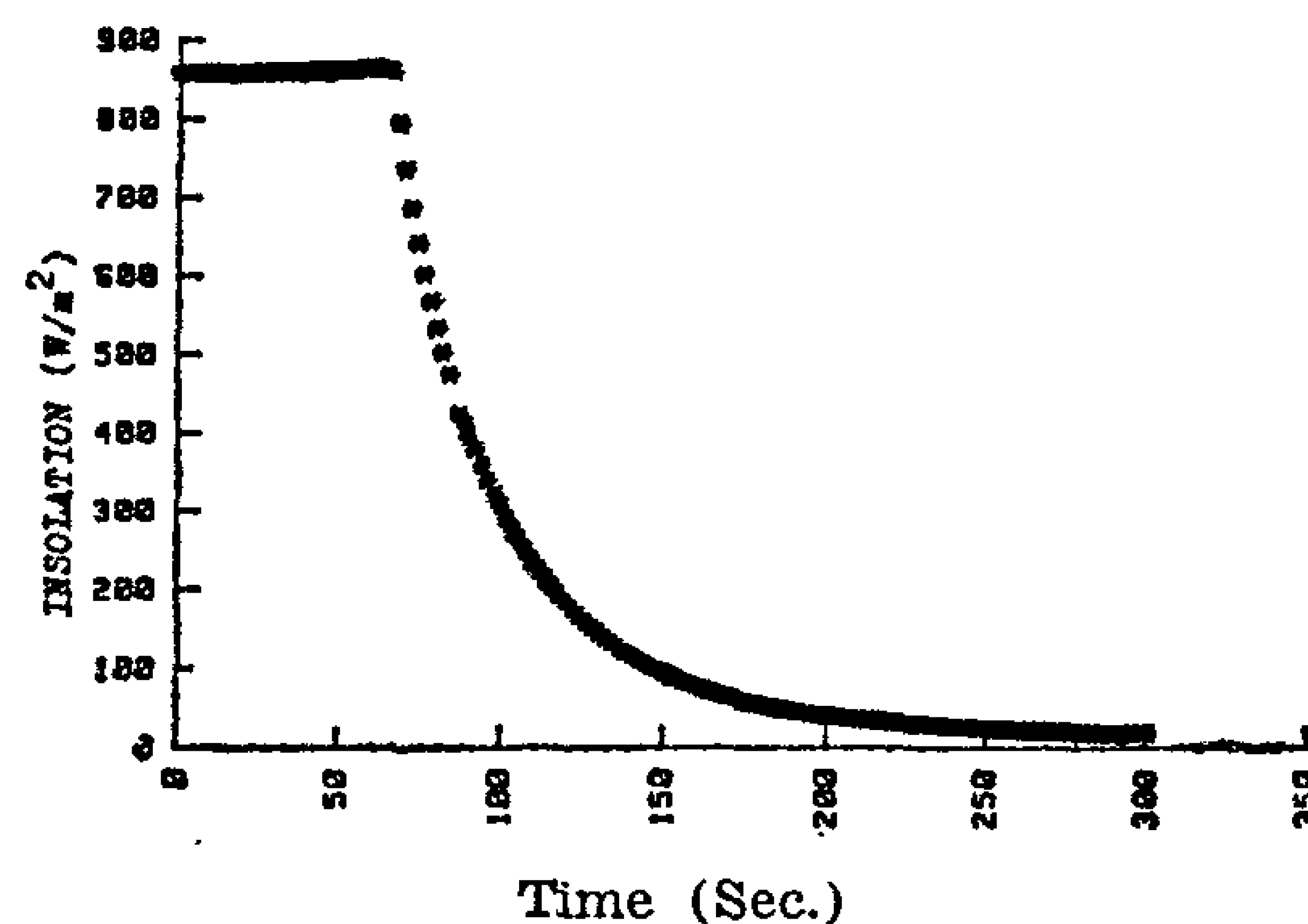


Fig. (8) Pyranometer Time Constant Test

Pyranometer (II): This pyranometer is made by Haenni, Germany. In this pyranometer cold junction effects are compensated for actively using an integral amplifier. The pyranometer has the following specifications:

Pyranometer Sensitivity	100 mv/1000 W/m2
Spectral Response	0.25um to 7.5 um
Temperature Compensation	± 1% from -15 C to + 50 C
Cosine Response	± 1% from 0 to 90 degrees
Time Constant	100 msecond

Interfacing the pyranometers to the data acquisition unit. The pyranometers are connected directly to the 20 channel relay multiplexer assembly. The calibration constant for each pyranometer is incorporated into the measurements system software.

4.5. Wind Speed

Type of transducer: A cup anemometer is used to measure wind speed. The anemometer consists of three cups mounted on a vertical axis. These cups drive a generator which produces an AC signal proportional to wind speed.

Interfacing the anemometer to the data acquisition unit: As will be shown in the next paragraph calibration of the anemometer is based on frequency. Therefore the transducer is connected to the 100KHz reciprocal counter assembly through an 8 channel high voltage relay assembly. It should be noted that by using this configuration the reciprocal counter can accept more than one input signal. A signal coditioning circuit is needed to adjust the transducer signal to that required by the frequency counter. In the present system the same signal conditioning circuit which has been described in connection with the flow transducer is used. The circuit is interfaced between the high voltage relay card and the counter card.

Calibration of the anemometer: Calibration of the cup anemometer was carried out by installing the transducer in a wind tunnel and measuring the air speed in the tunnel using a calibrated vane anemometer. Figure (9) gives the output signal

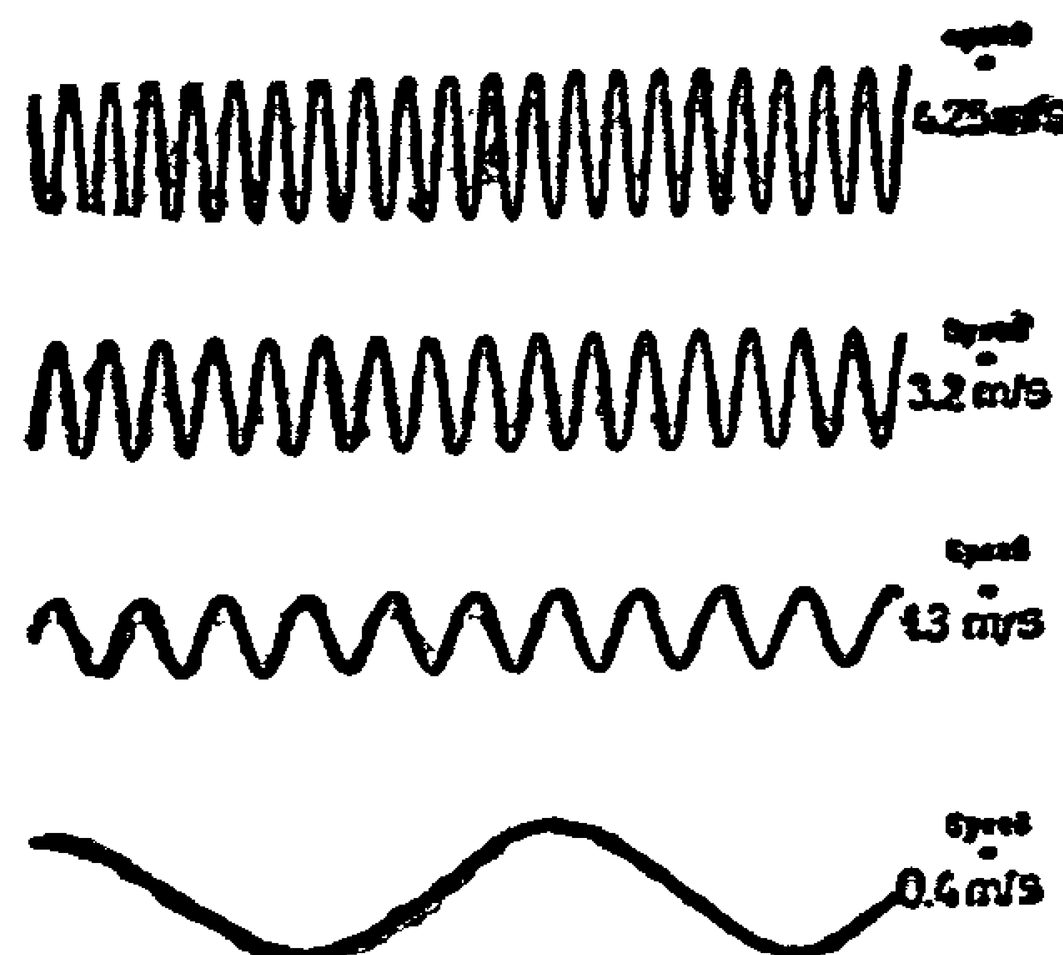


Fig. (9) Variation of Anemometer Signal with Wind Speed

ditioning circuit which has been developed to adjust the level of input signals to that corresponding to the high logic level of the counter assembly which is 5 volts, figure (7). The circuit consists of:

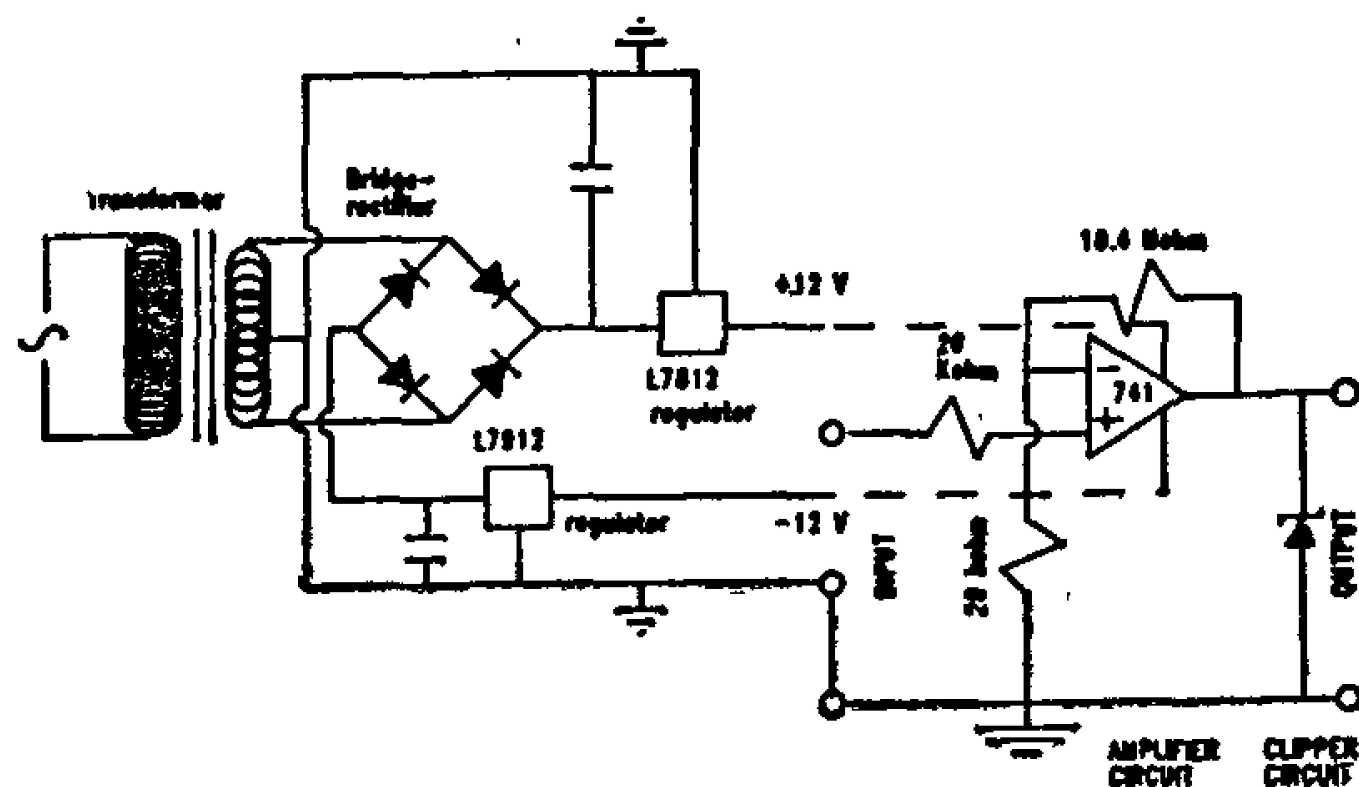


Fig. (7) The Signal Conditioning Ciruit

An amplifier circuit: This circuit is responsible for amplifying the flow transducer signal to bring it to the 5 volts level. The circuit is a non-inverting amplifier circuit which uses a uA 714 C operational amplifier, a feed back resistance of 10.4 Mohm, and an input resistance of 20 Kohm. The amplifier is connected to the ground through a 20 Kohm resistance in order to minimize the offset current effects.

A clipper circuit. As the output voltage from the amplifier will exceed the 5 volts level required by the counter circuit, a clipping element, 5 volts zener diode, is incorporated into the signal conditioning circuit.

A dual voltage power supply circuit: A $\pm$ 12 volt dual power supply circuit is incorporated in order to drive the operational amplifier. The circuit consists of a full wave bridge rectifier connected to the end terminals of a center tapped transformer whose center terminal is grounded, two constant voltage regulators, an L 2812 for the positive supply and an L 7912 for the negative suppley, two capacitors acting as low pass filters are added for each of the positive and negative supply sides.

Calibration of transducers: The primary method for flow rate calibration has been used in the calibration of transducers. The method is based on the establishment of steady flow through the transducers to be calibrated and the subsequent measurement of the mass of the fluid that passes through the transducers at an accurately timed interval. It was found that the response of each of these transducers is linear and their calibration equations are included in the software of the measurements system.

4.3. Ambient Air Temperature

Type of sensor: A high precision thermistor is used to measure the ambient air temperature. The probe is enclosed in a naturally aspirated head. The calibration of this transducer was carried out using a thermocouple probe. Regular calibration of this probe is also undertaken in order to account for the inherent instability of the thermistor.

Interfacing the sensor to the data acquisition unit: The probe is connected to one of the channels of the 20 channel relay multiplexer card. Resistance of the thermistor is measured by connecting the current source output from the data acquisition to the Decade B COMMON connector of the relay multiplexer, When the current source is set for a specified output (10 uA, 100 uA or 1mA) and the channel relay is closed, the voltage drop across the channel resistance can be measured, since the current is known the resistance can be computed.

4.4. Solar Radiation

Type of transducers. Two different pyranometers for measuring global and diffuse radiation are available at the laboratory. **Both of them are of the thermopile type.** The following is a description of these pyranometers.

Pyranometer (I). This Pyranometer is made by Hollis Geosystems, U.S.A. In this pyranometer cold junction effects are compensated for passively using a dual differential thermopile circuit. The pyranometer has the following specifications:

Type (II) flow meter. This meter has been developed at the solar energy laboratory[5]. The meter is based on a locally manufactured turbine flow meter.

The transducer circuit uses an infrared photodiode. The photodiode produces output voltage which is interrupted as the turbine rotates. The output of the transducer is, therefore, a train of voltage pulses whose frequency is proportional to the volume flow rate. Figure (6) shows the transducer output signal as monitored by the oscilliscope.

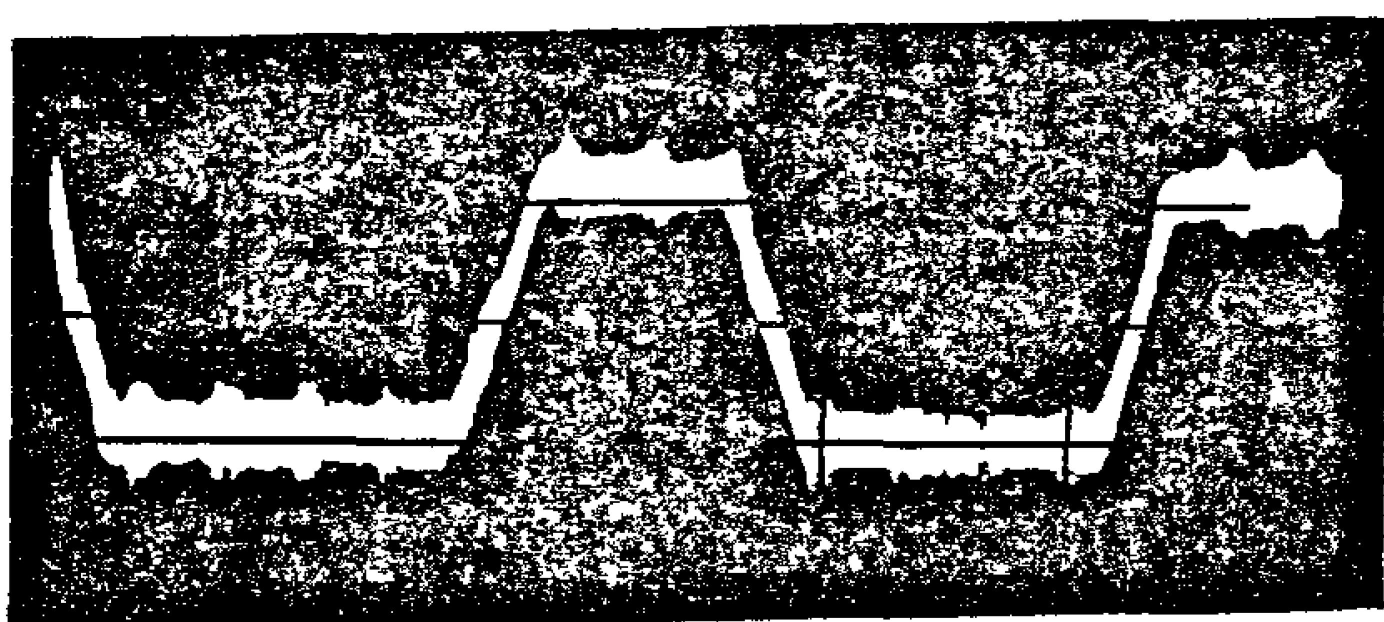


Fig. (6) Shape of Output Signal, Type (II) Flow Meter.

Interfacing the transducer to the data acquisition unit. As has been mentioned above the flow transducers will output an electrical signal at a level of roughly 0.1 volt and a frequency proportional to the flow rate. The frequency of the output signal will be measured using the frequency counter assembly card of the data acquisition unit.

The counter assembly card accepts only one input signal, therefore in order to allow for more than one transducer in the measurements system the transducers are connected to an 8-channel high voltage relay assembly card. The assembly card is used here as a multiplexer for the transducers. However the level of the transducer signals has to be adjusted to that required by the counter assembly. Moreover the measurements technique is also dependent on the counter assembly characteristis. A brief description of the counter assembly is given below.

The 100 KHz reciprocal counter assembly. The courter can measure periods of signals having frequency in the range from 0.0001 Hz to 100 KHz and pulse width down to 18 mircosecond .

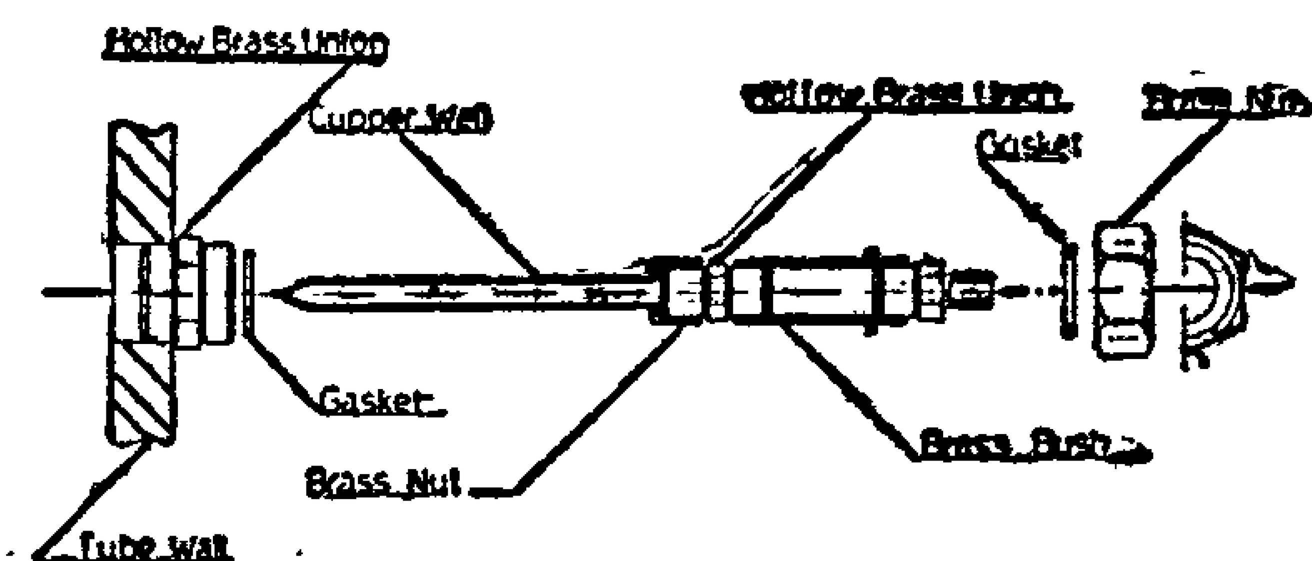
Generally, the counter circuit utilizes the reciprocal counter technique which is simply counting the number of complete cycles generated by an internal clock during a given time interval determined by the period of the input wave to the counter. The input wave triggers the internal clock cycles count on and off. This triggering process is optionally chosen to be either on the rising or falling edge of the input wave. To detect either of the rising or falling edge the counter has to detect either a LO to HI transition of input signal or vice versa respectively. Consequently the counter operates on two logic levels, a HI logic level and a LO logic level

The HI logic level corresponds to an input signal level between 4.2 and 5 volts and the LO logic level corresponds to an input signal level between 0 and 1 volts. The result is displayed directly in time units indicating the period of the input wave.

A signal conditioning circuit is therefore needed to interface the counter assembly circuit to the transducers.

Measurement technique: The counter allows the option of choosing one of four functions for period measurements. The first function averages the period of cne thousand waves of input signal while the second function averages the period of one hundered waves. They both have an accuracy of 1 microsecond. The third and fourth functions measure the period of only one wave of input signal. Hence they require a shorter measuring time but with an acuracy of one hunderedth of a second.

The signal conditioning circuit: The following is a description of the signal con-



Fiig. (4) Thermocouple Well

Interfacing thermocouples to the data acquisition unit : Thermocouples are connected directly to the terminal card of a 20 channel relay multiplexer assembly card. The card can be used to switch signals from up to 20 channels to the DVM or to other assemblies or instruments. The terminal card also has a temperature compensation circuit and an isothermal block for thermocouple measurements. The channels are organized into two decades of 10 channels. Relays can be closed in random fashion or can be incremented between programmable limits. One channel can be closed in each decade, i.e. two channels (one per decade) can be closed at a time.

Thermocouple compensation. The DVM does not measure temperature, but rather measures voltage generated by thermocouples. This measured votage can then be converted into an equivalent temperature through a computer program.

The problem with this approach is that the measured voltage is different from the actual thermocouple voltage, due to junction volages, unless some compensating techniques are used.

The assembly is set for software compensation.With software compensation a reference junction transducer measures the voltage of an isothermal block. This voltage is a function of the temperature of the block and is input to one of the channels of the multiplexer, channel B9. To arrive at the true thermocouple temperature the computer program, through the controller, should perform the following steps :

1—Measure the voltage from the reference junction transducer and convert it to an equivalent reference temperature, 100 mV/degree. C, i. e, 2.5 V at 25 deg. C, 2-Convert the reference temperature to a thermocouple voltage. The thermocouple voltage depends on the type of thermocouple being compensated. 3-Measure the voltage produced by the thermocouple and add the voltage computed in step 2 to this voltage for an ice point reference voltage. 4-Convert the total voltage in step 3 to an equivalent temperature.

The National Bureau of Standards ,N.B.S., thermocouple tables are used for thermocouple voltage-temperature conversion.

4.2 Water Flow Rate

Type of transducer. Two different types of turbine flow meters are available at the laboratory. The first type will be hereafter referred to as type (I) flow meter while the second type will be referred to as type(II) flow meter. The following is a description of the two types.

Type (I) flow meter. Basically, it is a miniature axial flow turbine suspended freely in a pipe with the only physical connection between the turbine and its housing is the turbine bearing. The rotation of the turbine is sensed by a pick up coil. A permanent magnet is encased in the turbine body. The rate of change of magnetic flux, produced by the rotation of the turbine wheel, inside the core of the coil generates a sinusoidal output voltage at the pick up terminals whose frequency is proportional to the flow rate. An output signal as seen on the oscillesoope screen is shown in figure (5).

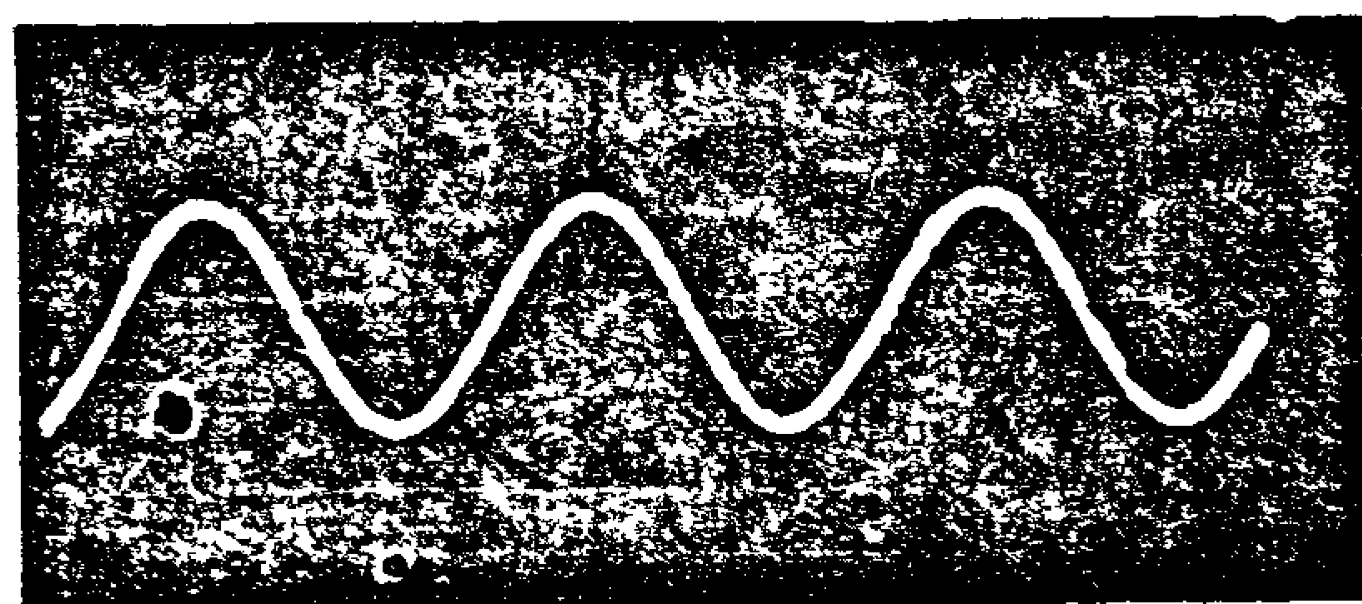


Fig. (5) Shape of Output Signal, Type (I) Flow Meter.

II) The signal conditioning stage. This stage modifies some of the transduced signals into a form usable by the final stage. In the present measurements system a signal conditioning circuit has been developed to bring the signals of the flow meters and the wind anemometer to the level required by their respective signal processing card of the data acquistion unit. Description of the circuit will be given in connection with the interfacing techniques of these transducers. Other transducer outputs do not need signal conditioning and these transducers are therefore connected directly to their respective signal processing cards of the data acquisition unit.

III) The data acquisition and control stage. The data acquisition and control equipment consist of :

1) An hp 1.5 M byte RAM, 16/32 bit microprocesser, also called the controller.

2) Dual 3.5 inch, 720 k, disk drive.

3) A graphics plotter.

4) A printer.

5) A data acquisition and control unit. The unit provides the necessary interface between the sensors and transducers or the signal conditioning circuits and the microprocessor. The following is a breif description of the unit.

3.1 The Data Acquisition Unit

The data acquisition unit has a built in real time clock and timer. The real time clock can provide complete timing for data with 1 second resolution. In addition the timer can be used to monitor elapsed time from a defined start point.

The data acquistion unit also has a built in digital voltmeter.The DVM is a $5\frac{1}{2}$ digit, 1 microvolt DC voltmeter which can measure DC volts up to 119.999 volt. The partial digit which is the most significant digit can only be 0 or 1. Maximum reading rate depends on the number of digits to be displayed, with 40 readings per second for 5.5 digits, and 166 readings per second for 4.5 digits and 250 readings/second for 3.5 digits display for 50 Hz operation. DC voltages to be measured can either be input to the rear panel terminal or analog assembly terminal cards. When voltages are input to analog assemblies, sequential channel to channel scanning can be realized. The DVM contains a current source which is used with the DVM for accurate resistance measurements. The current source outputs one of three programmable constant currents : 10 uA, 100uA, 1 mA, depending on the command used. The unit has 5 slots which can house a combination of up to 5 signal processing cards, assemblies, such as cards which accept analog signals, digital signals, frequency, ... etc, as well as actuator cards. Description of these cards will be given in connection with the sensors and transducers connected to them.

4. MEASUREMENT OF SOLAR THERMAL SYSTEM VARIABLES

4.1. Collector Inlet and Outlet Temperatures

Type of sensors. Type T thermocouple wire was used to manufacture thermocouple probes. The tip of the thermocouple wire is cold welded to a copper well to form a probe as shown in figure (4). This technique is superior to soldering or welding. Since in case of soldering the junction is suseptible to thermal fatigue, while overheating when welding can degrade the wire as the welding gas and the atmosphere in which the wire is welded can both diffuse into the thermocouple metal, changing its characteristics This difficulty is also compounded by the very different nature of the two metals being welded.

The present paper describes in detail the solar energy laboratory which has been built and equipped to serve as an advanced testing facility for testing solar systems. The purpose of the facility is four fold : (1) to determine the instantaneous efficiency curves for the solar collectors under developement at Ain Shams University (2) to evaluate long term durability and performance characteristics of solar collectors; (3) to evaluate solar thermal systems performance under actual operating conditions (4) to provide information regarding the effect of environmental conditions such as pollution on the performance of collectors as well as systems.

2. THE SOLAR ENERGY LABORATORY

The solar energy laboratory is located in 16x12 square meter area on a roof top to the south of one of the buildings of the faculty of engineering, Ain Shams University. Figure (1) provides a pictorial overview of the outdoor test facility. A close-up for one of the test rigs is shown in figure(2) which also shows some of the instrumentation; a solar pyranometer placed on the plane of a solar collector, a wind speed anemometer and a wind direction vane. The inhouse built data logging, recording, control and processing equipment are shown in figure(3).

3. THE MEASUREMENTS SYSTEM

The possibilities for putting together an advanced measurements system are almost open ended. The degree of completeness is usually limited by system cost and objectives. The measurements system as installed at the solar energy laboratory consists of three stages :

I) Detecting stage; the sensor transducer stage. A detailed description of the sensors and transducers which are presenently installed on the test rigs is given in section 4.



Fig. (1) The Outdoor Testing Facility

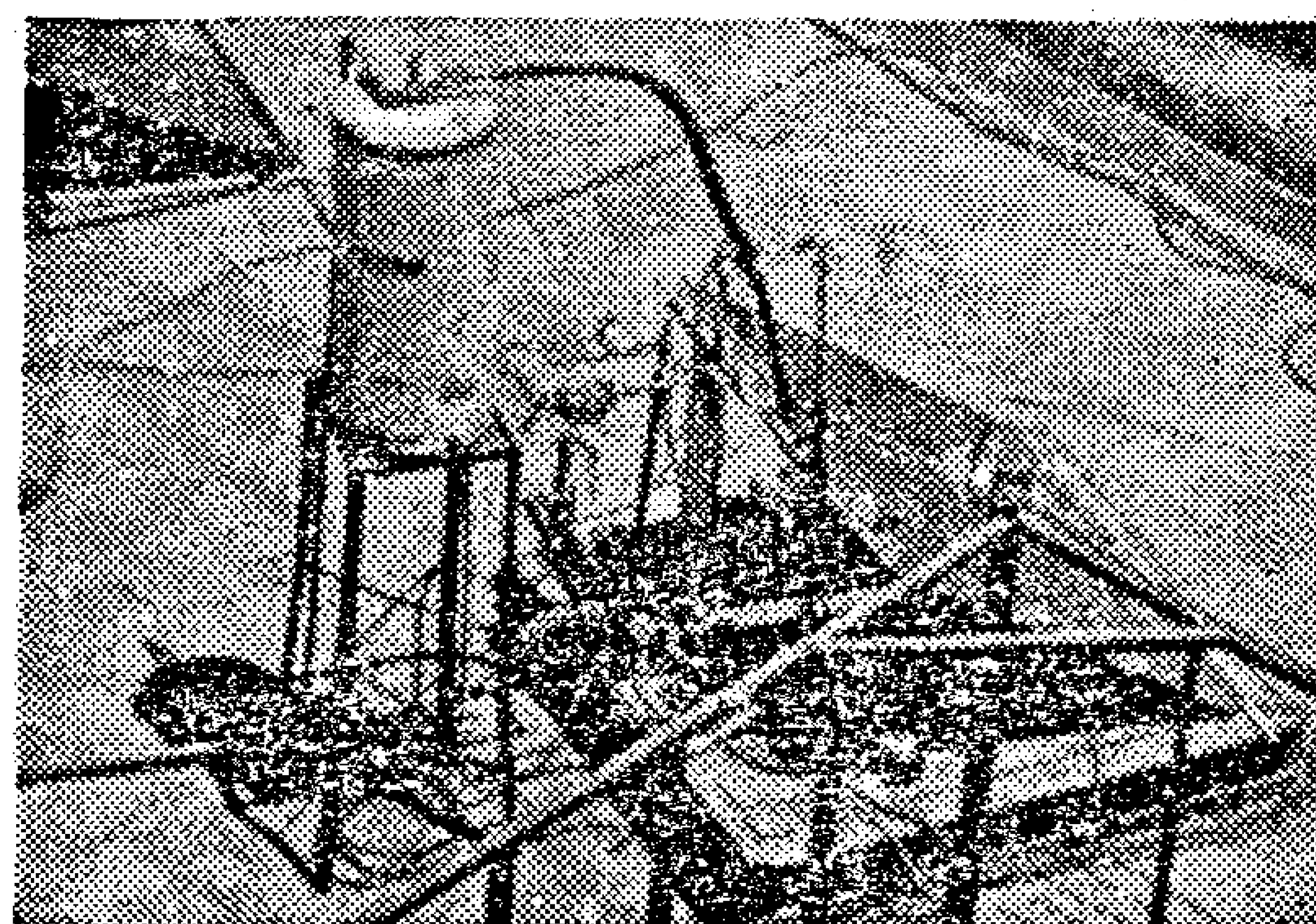


Fig. (2) A Close up for One of The Test Rigs

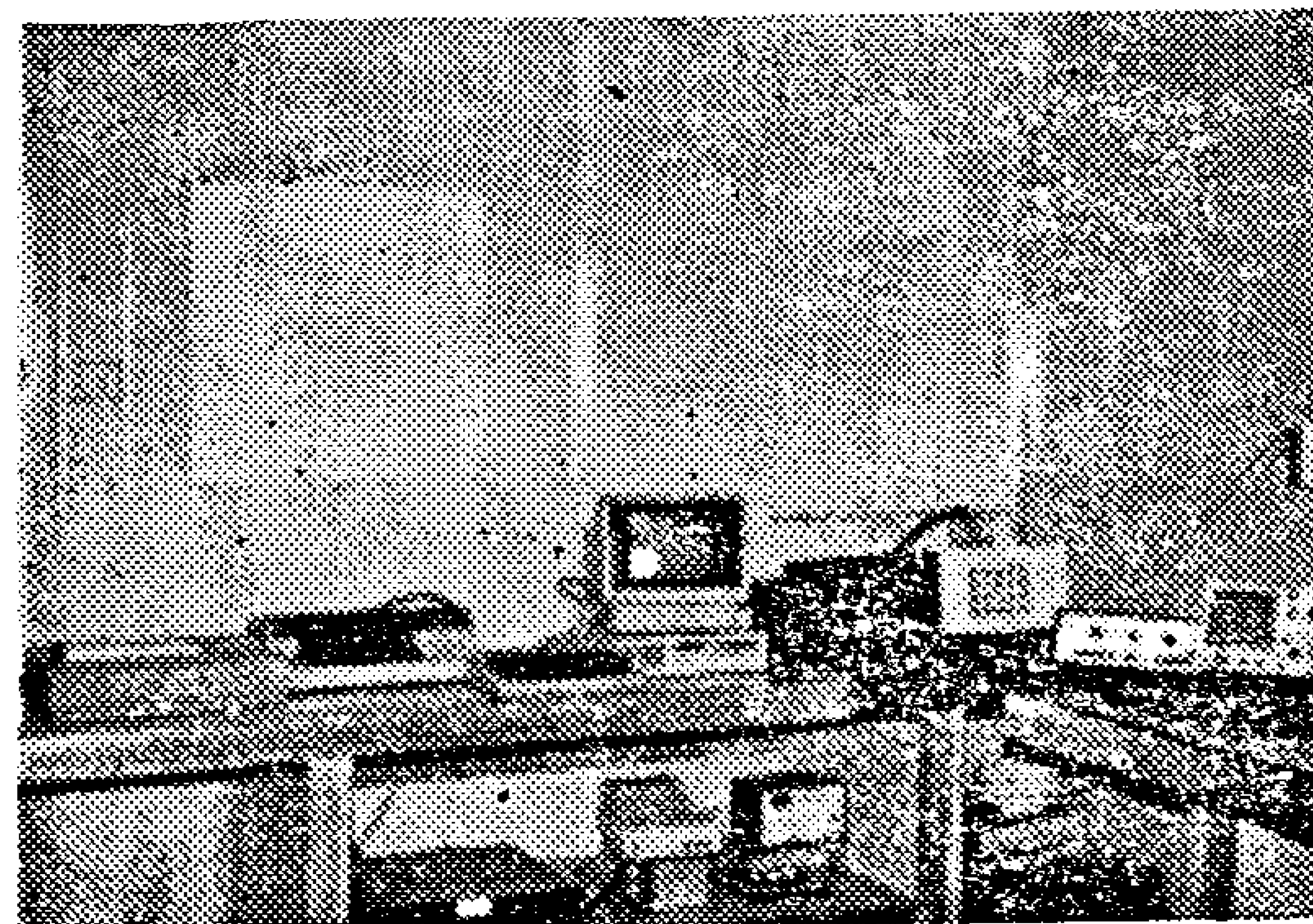


Fig. (3) Data Acquistion and Control Equipment

A MICROPROCESSOR BASED DATA ACQUISITION AND MEASUREMENTS SYSTEM FOR MONITORING THE PERFORMANCE OF SOLAR THERMAL SYSTEMS

Dr. Z. GHONEIM*

ABSTRACT

The paper presents a detailed description of the data acquisition and measurements system which has been installed at the solar energy laboratory, faculty of engineering, Ain Shams University. The system is an advanced microprocessor based measurements system which has the capability of automatically taking measurements at pre-set times and at any scanning rate and as such can work as a stand alone data acquisition and measurements system.

The paper gives a detailed description of all the sensors and transducers of the system, the signal conditioning circuits which have been developed to interface some of the transducers to their respective signal processing modules of the data acquisition unit as well as the interfacing and measurements techniques.

Finally a sample of meteorological data and a set of outdoor performance curves pertaining to a solar water heating system are presented.

1. INTRODUCTION

Fossil fuels particularly, oil and gas, which presently provide most of our energy needs, are being rapidly depleted. Efforts are therefore being directed towards the development of alternative energy sources particularly solar and wind energy.

The potential of wind energy utilization in Egypt is largely restricted to the Mideterranean and Red Sea costs.

As for solar energy, Egypt lies within the sub-tropical region in the northern hemisphere (31 — 22 degrees). It is one of the countries which has the most sun shine hours per year, ranging from 3000 to 4000 hours with the total solar intensity incident on horizontal surface ranging from 4.6 to 8.4 KWH/sq. m a day at Lower Egypt and from 7.2 to 10.8 KWH /sq. m a day at Upper Egypt. Solar energy utilization, either in thermal systems or in electricity production has therefore a great potential. However the immediate application of solar energy should be in thermal systems for two main reasons :

1) The technological know how required for the production of such systems is fairly well established.

2) From a thermodynamic point of view these systems have a unique and most attractive feature which is the feasibility of matching a means of collection to a braod range of tasks which operate over a large range of temperatures.

In Egypt, solar water and air heating industry is still in its infancy. Extensive work is therefore needed in order to develop our own technology.

At the faculty of engineering, Ain Shams University, a long term research program has been undertaken in order to develop cost effective solar heating systems.

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111.2. **Summary of Conclusions :**

From the above analysis and discussions, the following more important conclusions, can be drawn:

1. Overall energy balances for the four major crops in Nile Delta were obtained successfully based on systemmatic analysis of survey quesonnaire form designed through the course of this work.

2. Field measurements of diesel pump and sakia performance were obtained with the aid of appropriate experimental laboratory equipment. Field measuremens of tractor performane in field preparation and driving harvesting machines were used to supplement the data oblained from survey.

3. It is clearly shown that clover is the highest productive crop per unit energy input with Maize as highest energy consumer per feddan-day.

Further work is to be carried out to quantify the net return of each crop/plot and to analyse the details of each agriculture machinary selection.

ACKNOWLEDGEMENT :

This work was partially supported by the Energy Research centre, Cairo University, Mx 842081, whose financial support is acknowledged. Thanks are due to Prof. M.N. Alaa Eldin, Drs. El Shimi, Abdel Aziz, Bahgatt, Hanafy for their valuable efforts. Thanks are also due to Mr. Carrol for the valuable discussions.

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for pump irrigation. When clover is considered, the yield per energy input is always the highest among the four magor crops. typically 4.37 kg/M cal input energy or 43.7 kg/kg f.o.e (kg f.o.e (corresponds to 10 (Mcal).

Ene:gy	Wheat		Maize		Clover		Cotton	
	S	P	S	P	S	P	S	P
Total Mcal/ Fed.	2169	2284	4695	4857	1376	1565	3938	4160
Endogenous %	32	27	66	61	88	69	65	58
Exogenous %	68	73	34	39	12	31	35	42

Table 2: ENERGY PRODUCTIVITY AND REQUIREMENT OF PRINCIPAL CROPS IN NILE DELTA CASE-STUDY VILLAGE

PRODUCTIVITY/REQUIREMENT	WHEAT (175 days)		MAIZE (120 days)		CLOVER (165 days)		COTTON (200 days)	
	Sakia	Pump	Sakia	Pump	Sakia	Pump	Sakia	Pump
GROSS ENERGY PRODUCTIVITY								
(kg prim.prod./Mcal input)	0.56	0.53	0.30	0.29	4.37	3.84	0.08	0.08
(kg sec.prod./Mcal input)	1.24	1.18	0.47	0.45			0.14	0.14
(kg tert.prod./Mcal input)							0.45	0.42
COMM. ENERGY PRODUCTIVITY								
(kg prim.prod./Mcal input)	0.83	0 73	0.89	0.76	37.4	12.5	0.23	0.18
(kg sec.prod./Mcal input)	1.82	1.61	1.37	1 17			0.41	0.32
(kg tert.prod./Mcal input)							1.27	1.00
GROSS ENERGY REQUIREMENT								
(Mcal input/T prim.prod [d.w.])	1780	1880	3290	3400	230	260	12100	12800
(Mcal input/T tot.prod. [d.w.])	560	580	1290	1340	230	260	1480	1570
COMMERCIAL ENERGY REQUIREMENT								
(Mcal input/T prim.prod [d.w.])	1210	1370	1130	1320	30	80	4260	5420
(Mcal input/T tot.prod. [d.w.])	380	430	440	520	30	80	520	660
"LABOR-LESS" ENERGY REQUIREMENT								
(Mcal input/T prim.prod [d w.])	1610	1720	2800	2930	90	120	6930	7690
(Mcal input/T tot.prod. [d.w.])	500	540	1100	1150	90	120	850	940

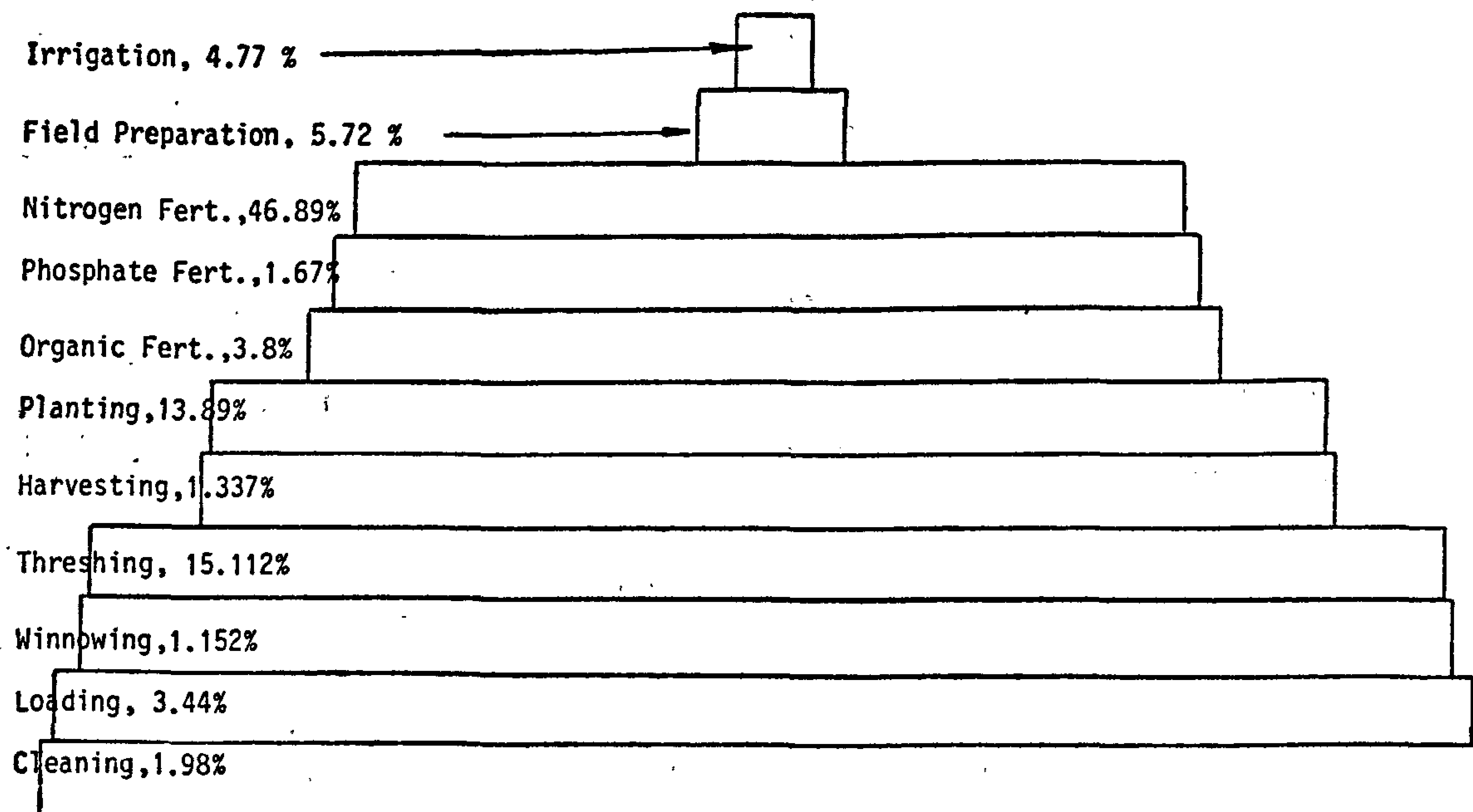


Fig. 7.

The diagram was devised on the principle of energy accumulation for agriculture processes with details of each process The detailed energy consumptions for the various crops were deduced from the analysis of the questionnaires(2). Several similar pyramids can be obtained from the corresponding data.

III. DISCUSSION OF RESULTS AND CONCLUSIONS:

III. 1. Discussion of Results:

The results shown earlier in the paper briefly summarize the finding of the survey and field measurement phase. Considering the complexity of the land ownership/planting and the handling of agriculture machinary, the obtained trends are indicative of the energy consumption patterns in a typical village in the Nile Delta. Out of the data collected on land ownership in Damhoug, the comparative GINI coefficeint for Damhoug was 0.47 which is vompared to that of Japan and China and correlates land holders to agriculture land distributions.

The energy requirement for wheat production was shown for a 5% of area application of baladi fertilizer (organic) which amounted to 2169000 kcal/feddan; it was found that with full treatment of organic fertilizer the total energy requirement would be 3836025 kcal/fed for sakia irrigation and 3852025 kcal/fed for pump irrigation. It is important to subdivide the energy consumed into indigenous portion which is consumed in the agriculture operations themselves and the exogenous portion which includes chemicals, fertilizers, fuels etc. For wheat, the indigenous portion amounts to 692600 kcal/fed corresponding to 32% for sakia operation and only 27% for pump irrigation. Table 1 shows this proportion for various crops:

S = Sakia P = Pump

Table 2 shows The energy productivity and requirement of principal crops in Damhoug. These are presented in terms of gross energy productivity as kg. product per Mcal input energy. For wheat production, 0.56 kg. are produced per one Million calori input; for fuel oil of 10 000 kcal/kg, this is equivalent to 5.6 kg/kg fuel oil equivalent. For Maize this ratio becomes 3 kg/kg f.o.e for sakia and 2.9

The endogenous energy in maize production corresponds to 66% and 61% for sakia and pump respectively. These ratios were 32% and 27% for wheat production.

The third crop is clover, which is the least energy intensive crop with a total energy consumption of 1376000 kcal/feddan out of which 62% is human labour to produce 6000 wholes, as indicated in figures 5a and 5b.

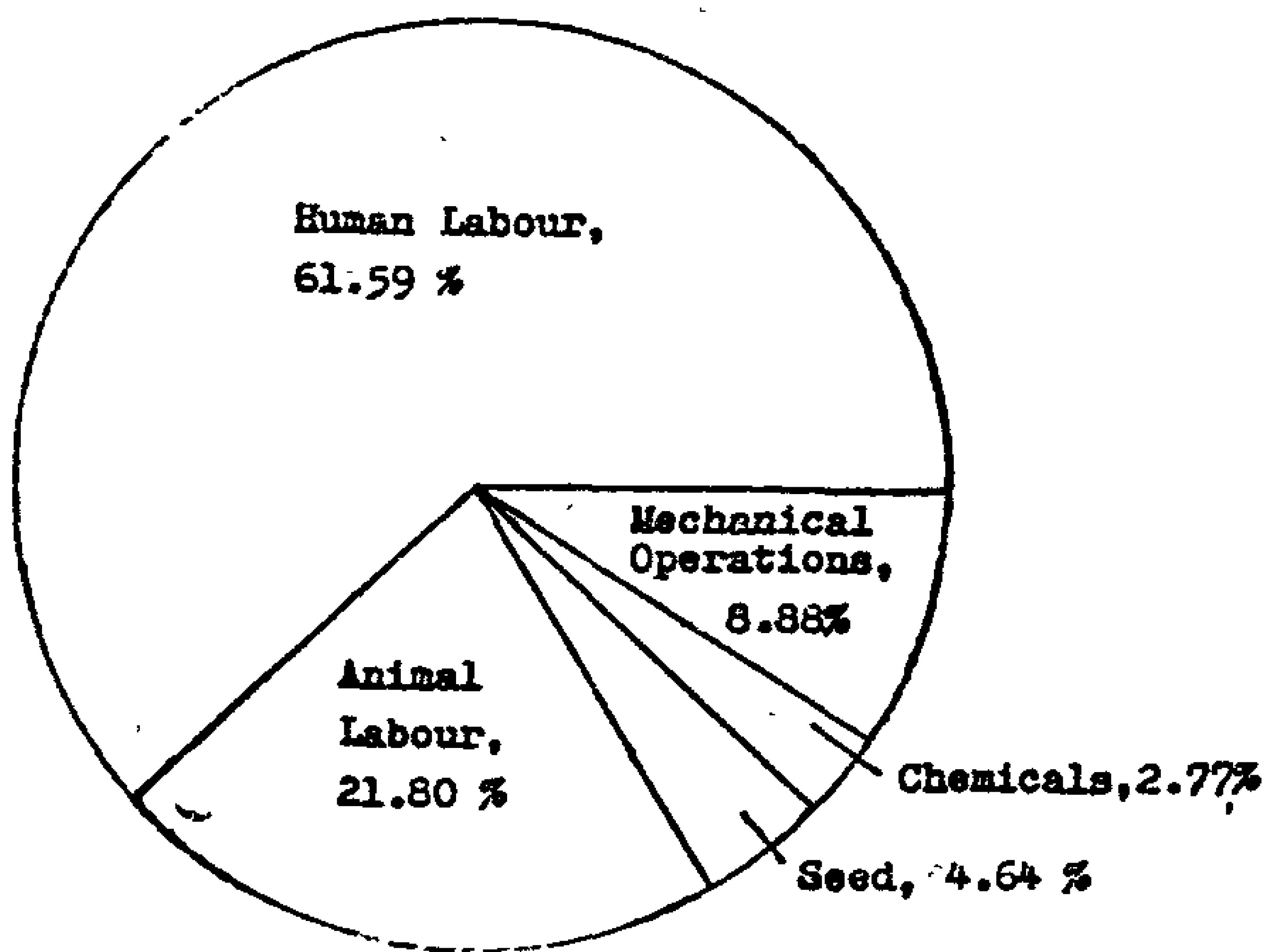


Fig. 5 a

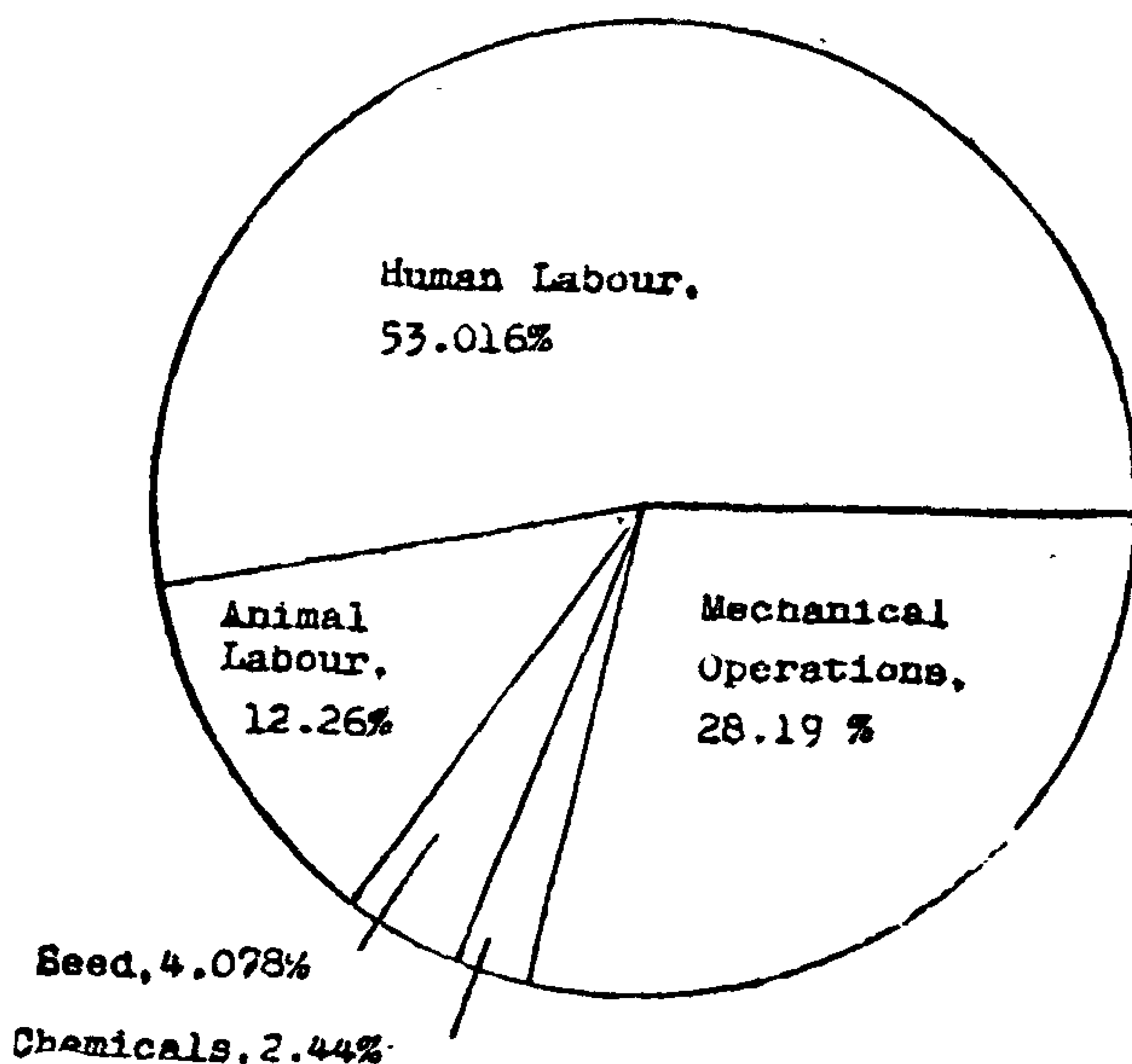


Fig. 5 b

The energy consumption for clover production is different than that for wheat; in the present case, chemicals represent the lowest energy consumption rate sources. The mechanical operation corresponds to 8.88% for sakia irrigation and 28,198% for diesel pump irrigation. The animal labour varies between 21.8% and 12,26% for sakia and pump irrigation respectively.

Figures (6a and 6b) represent the corresponding energy pie diagrams for the production of cotton; typically cotton lasts for 200 days in the field. The total energy consumed is 3938000 kcal/feddan for sakia irrigation and 4160000 kcal/feddan for pump irrigation. This energy is to produce 325 kg. of lint, 567 kg. of seeds and 1964 kg. of stems. The energy diagrams indicate 42.69% and 39.79% of energy consumed in human labour for sakia and pump irrigation respectively.

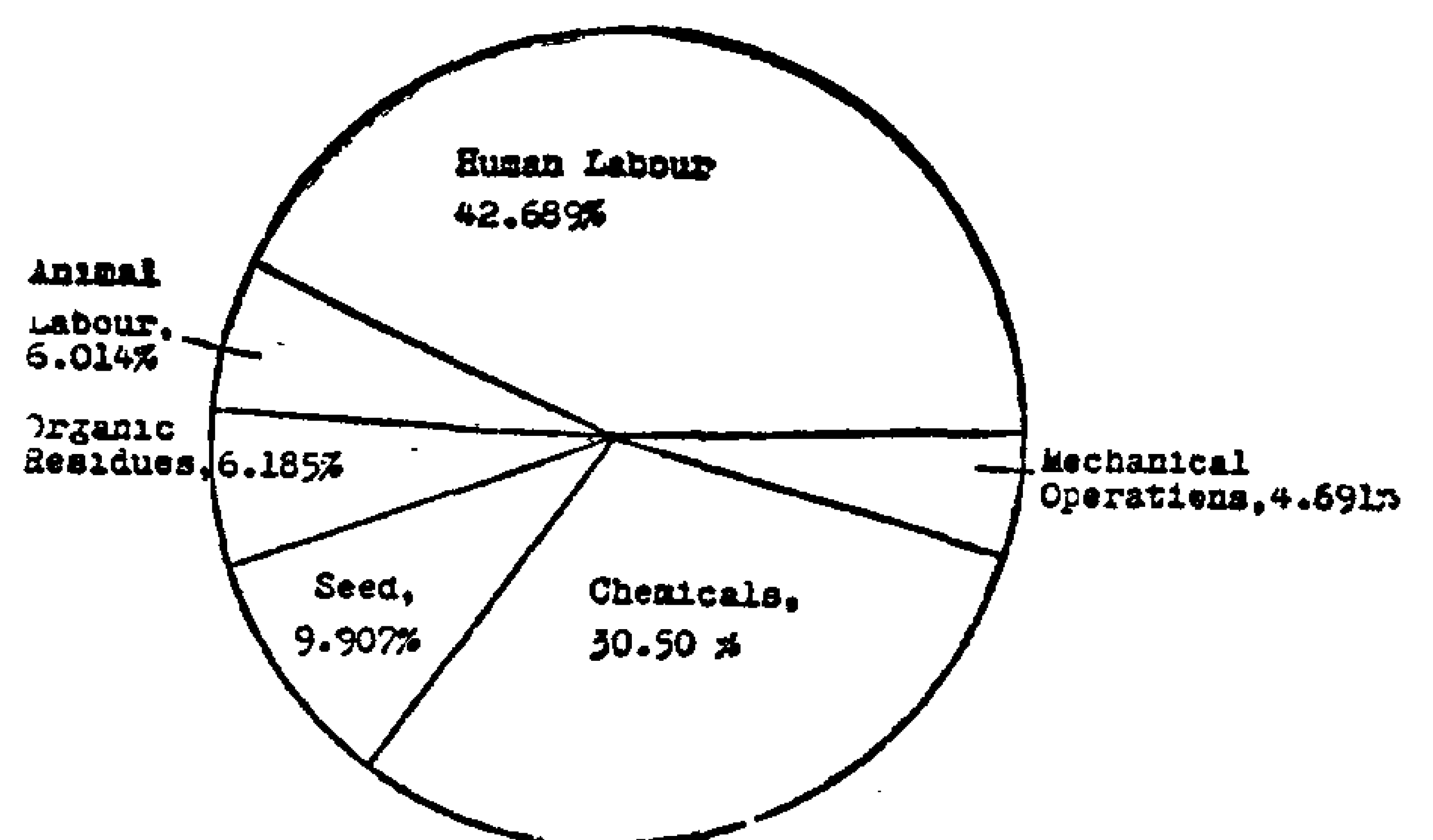


Fig. 6 a

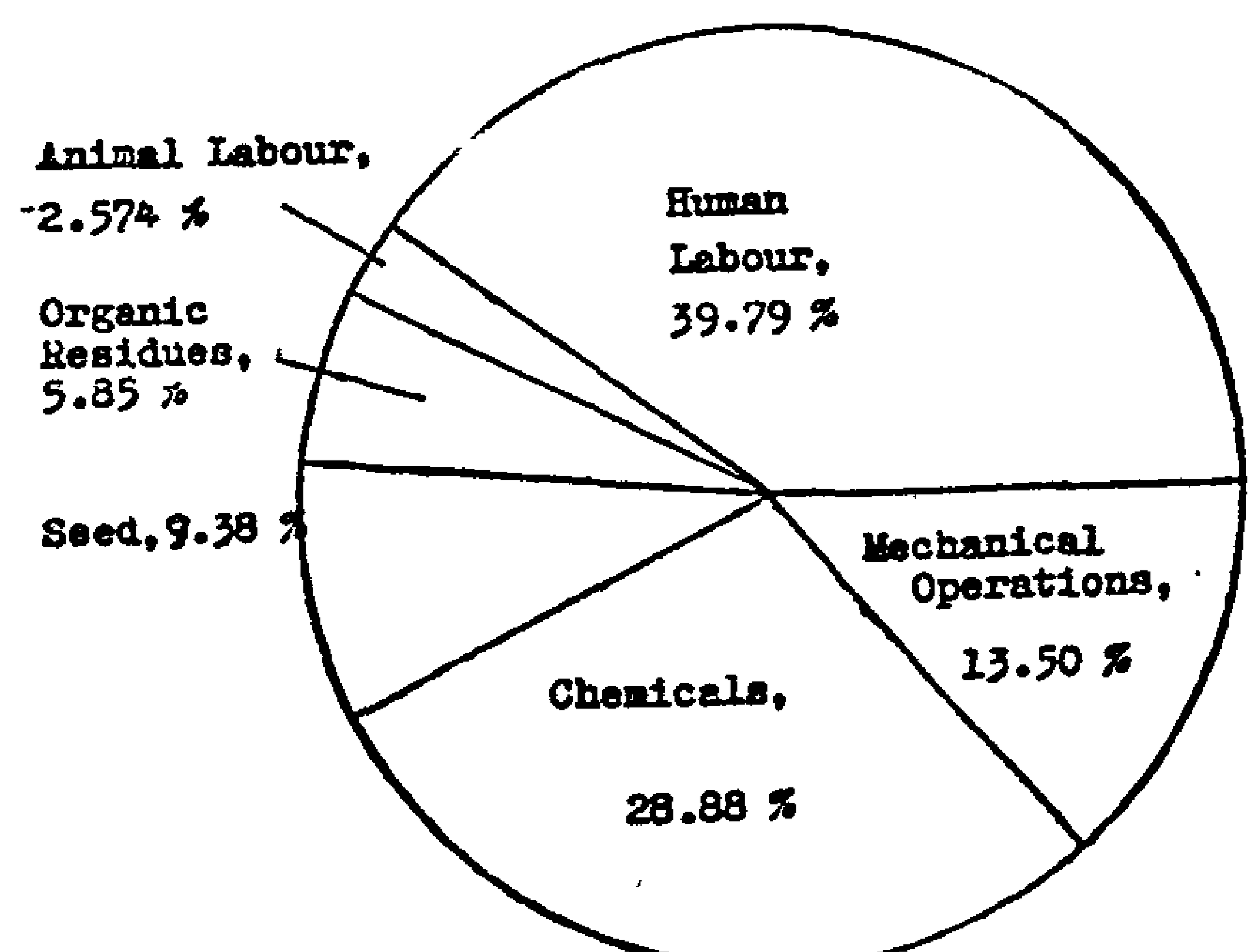


Fig. 6 b

Fgure (7) illustrates the energy pyramid for production of wheat, all values are per feddan.

total energy consumption of 2169000 kcal per feddan to produce 1300 kg. of grain at 93% dry matter and 3000 kg. of straw, 90% dry. The human labour in all operations amounted to 283 hours, in the 175 days of wheat production. These were divided as76% family labour and 24% hired labour. The human labour represented 9.3% of total energy. On the other hand, the animal labour is less in this case than that utilizing pumps for irrigation, typically, the animal labour contributed to 5.98% and is represented by 61 hours of animal work.

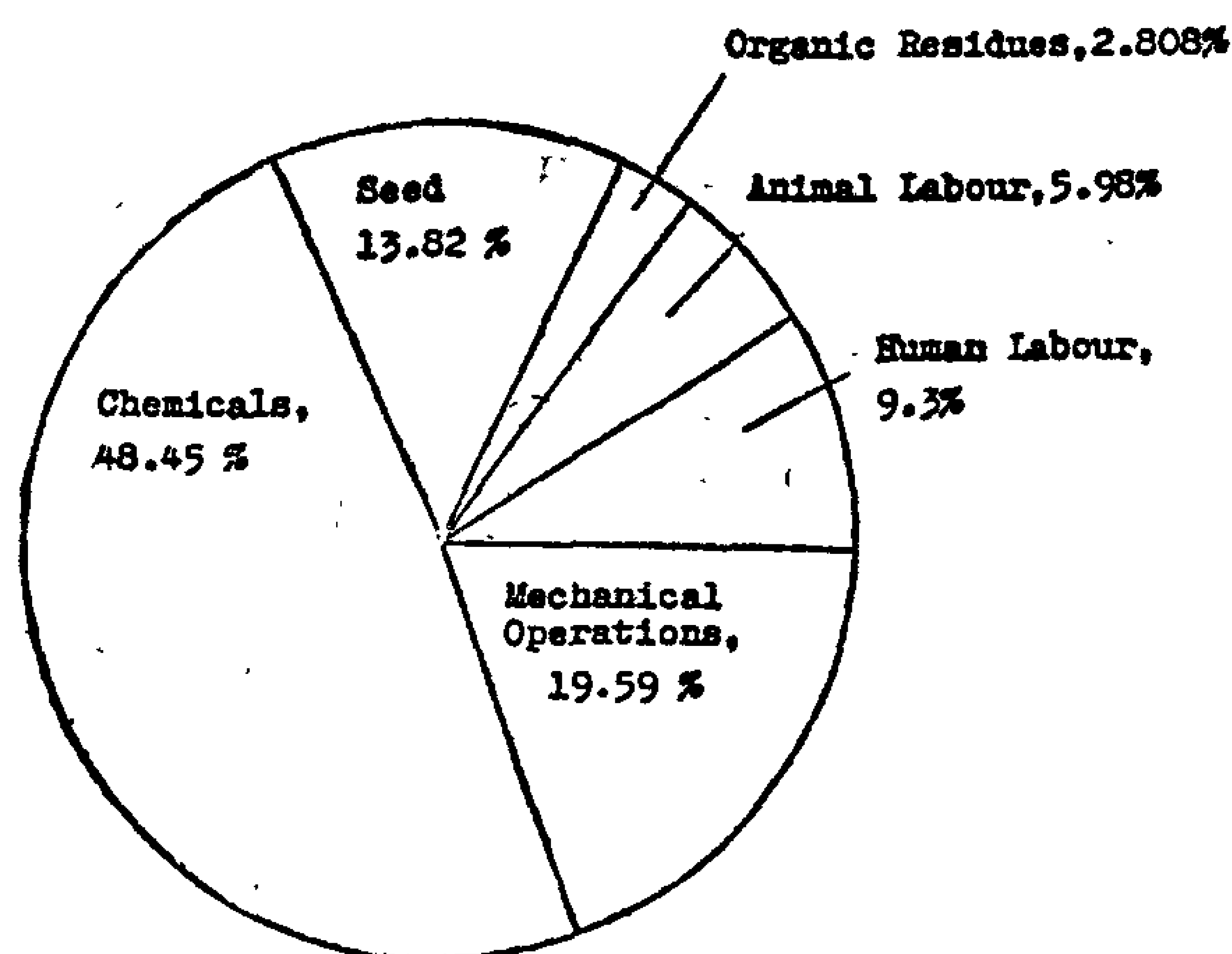


Fig. 3 a:

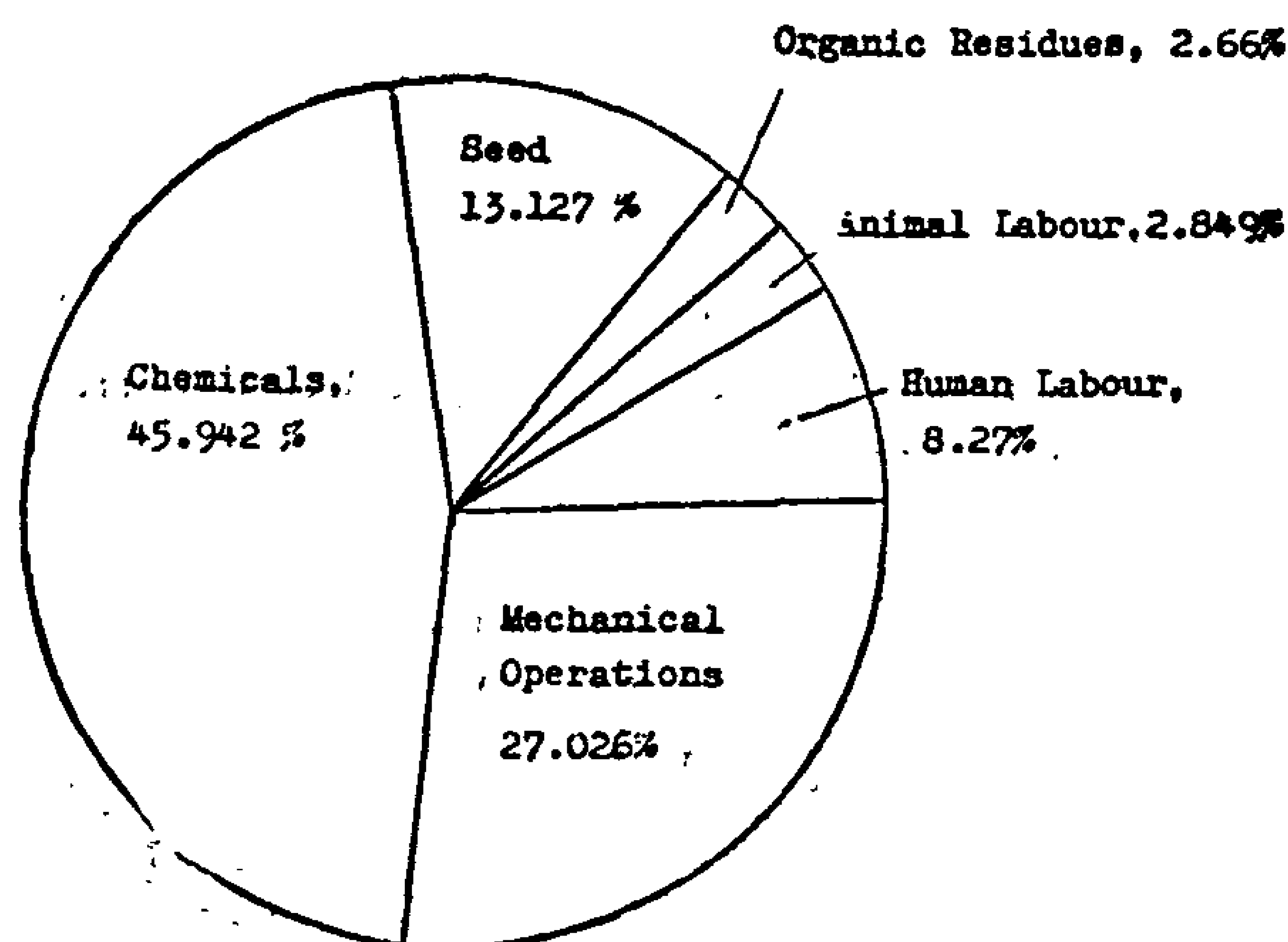


Fig. 3 b:

In the situation where a pump is used Fig. (3 b) the analysis of the questionnaires indicated 34 hours of animals. Organic residuals contributed to 2.808% of total energy consumption basen on 5% pro-rata of full treatment.

In figures (4 a) and 4b) the corresponding energy consumptions are shown in percentage of total energy, which amounted to 4685000 kcal per feddan for Maize production of 1428 kg. of dry grain, 1365 kg. stover and 840 kg. of cobs. The organic residuals application corresponds to nearly 39% of total energy consumption, typically 1.827000 kcal per feddan. The chemicals contribute to 31.2% with mechanical operations limited to 3%, human labour to 15% and animal labour to 8%, for sakia application as irrigation method.

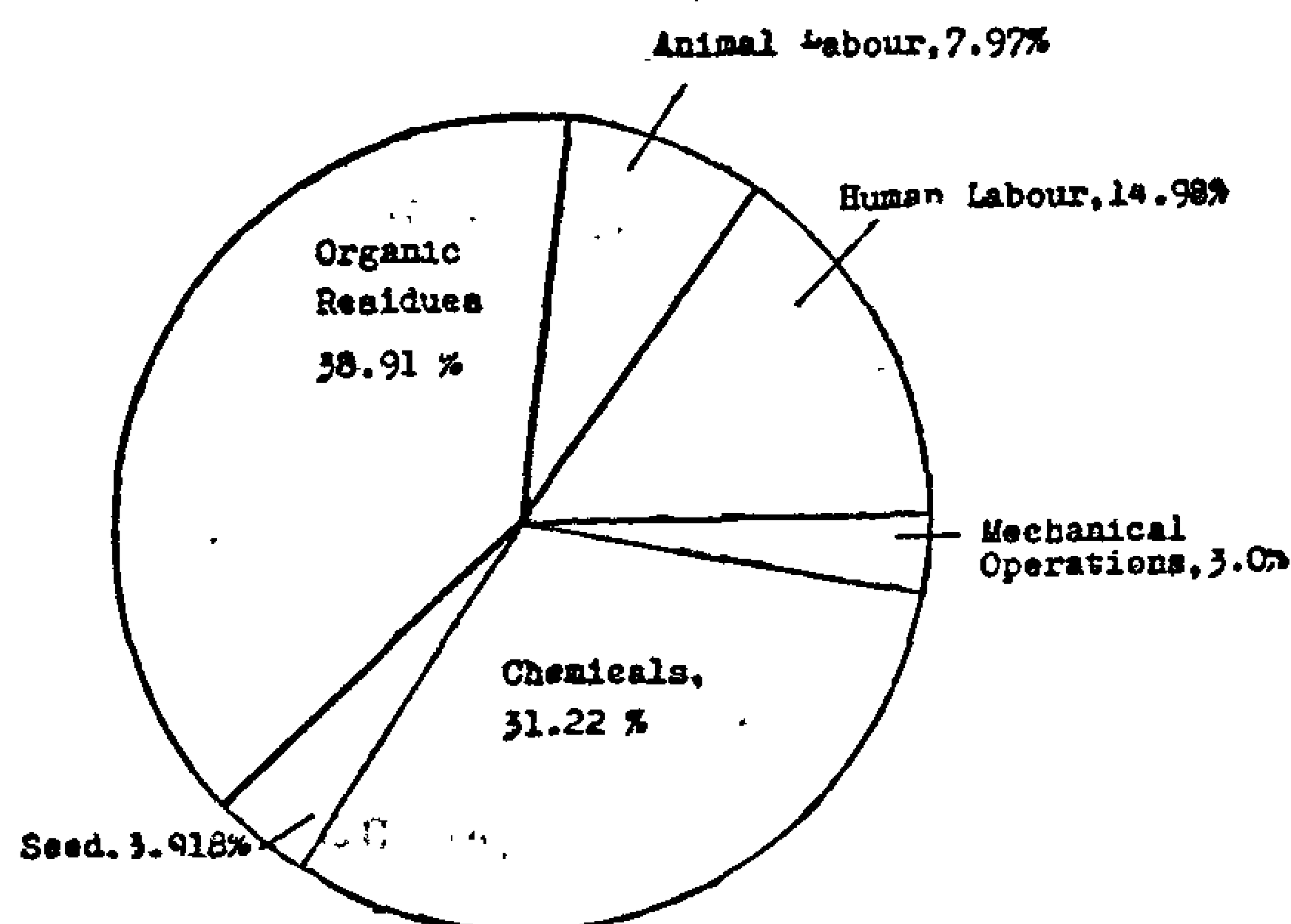


Fig. 4 a

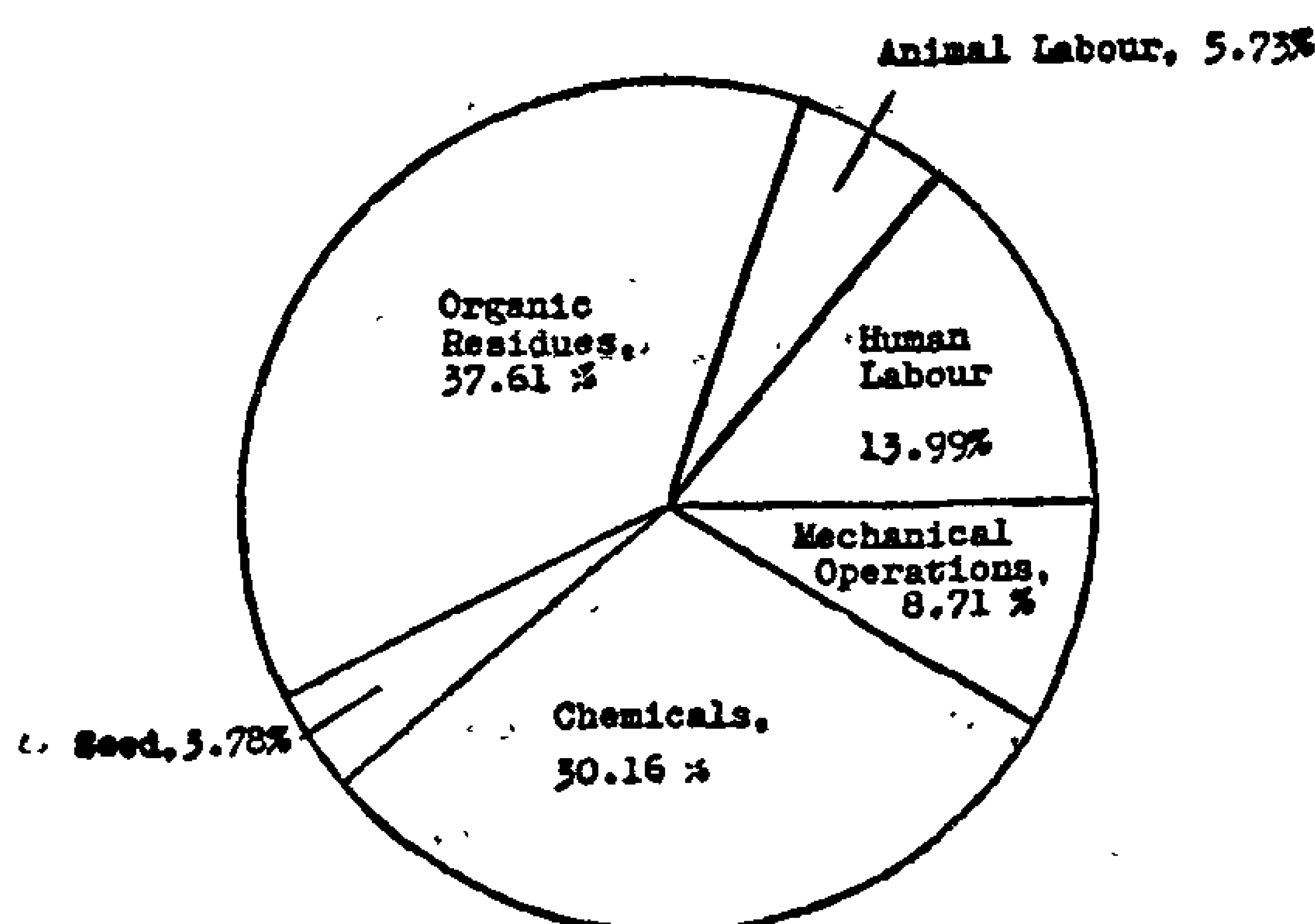
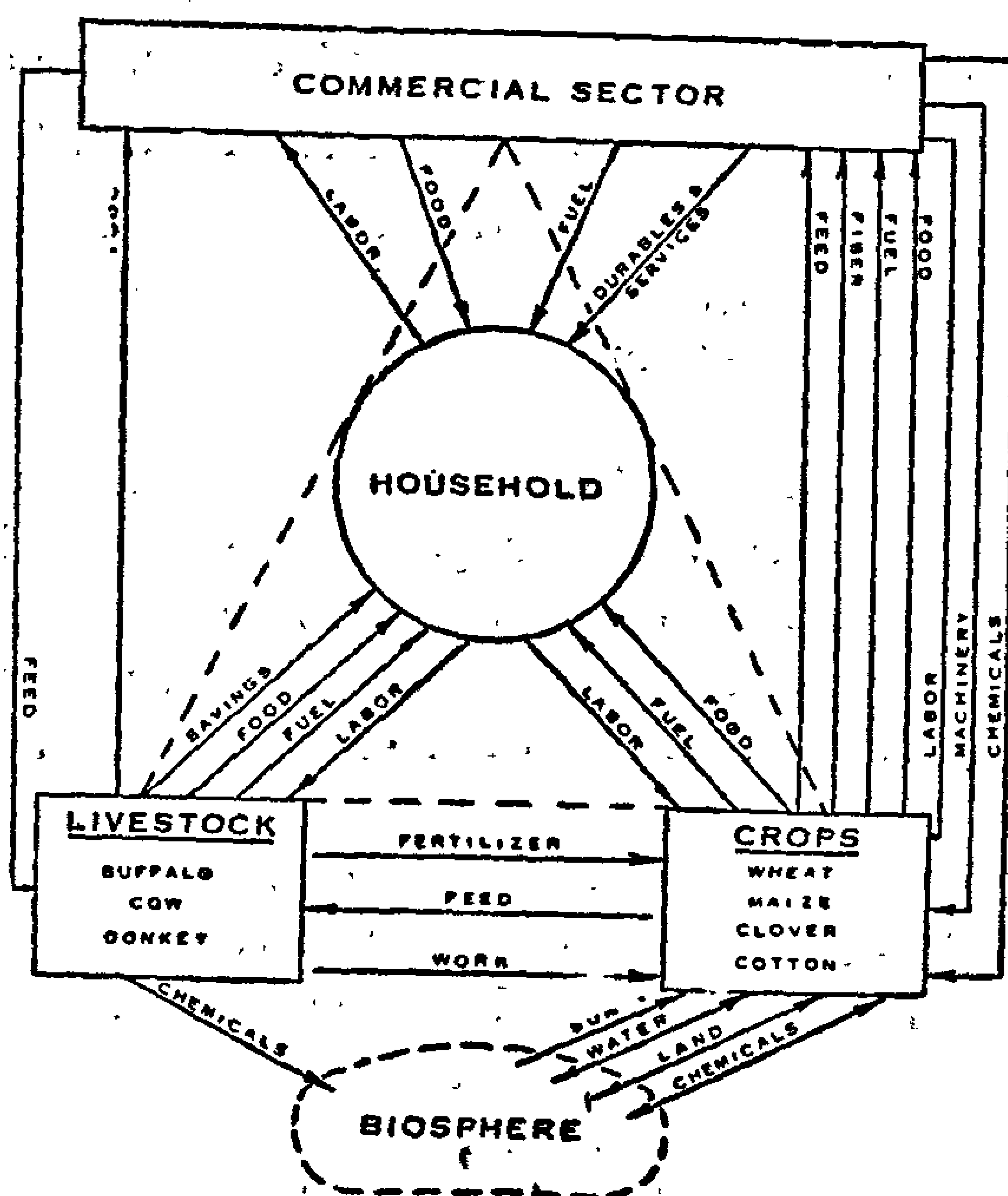
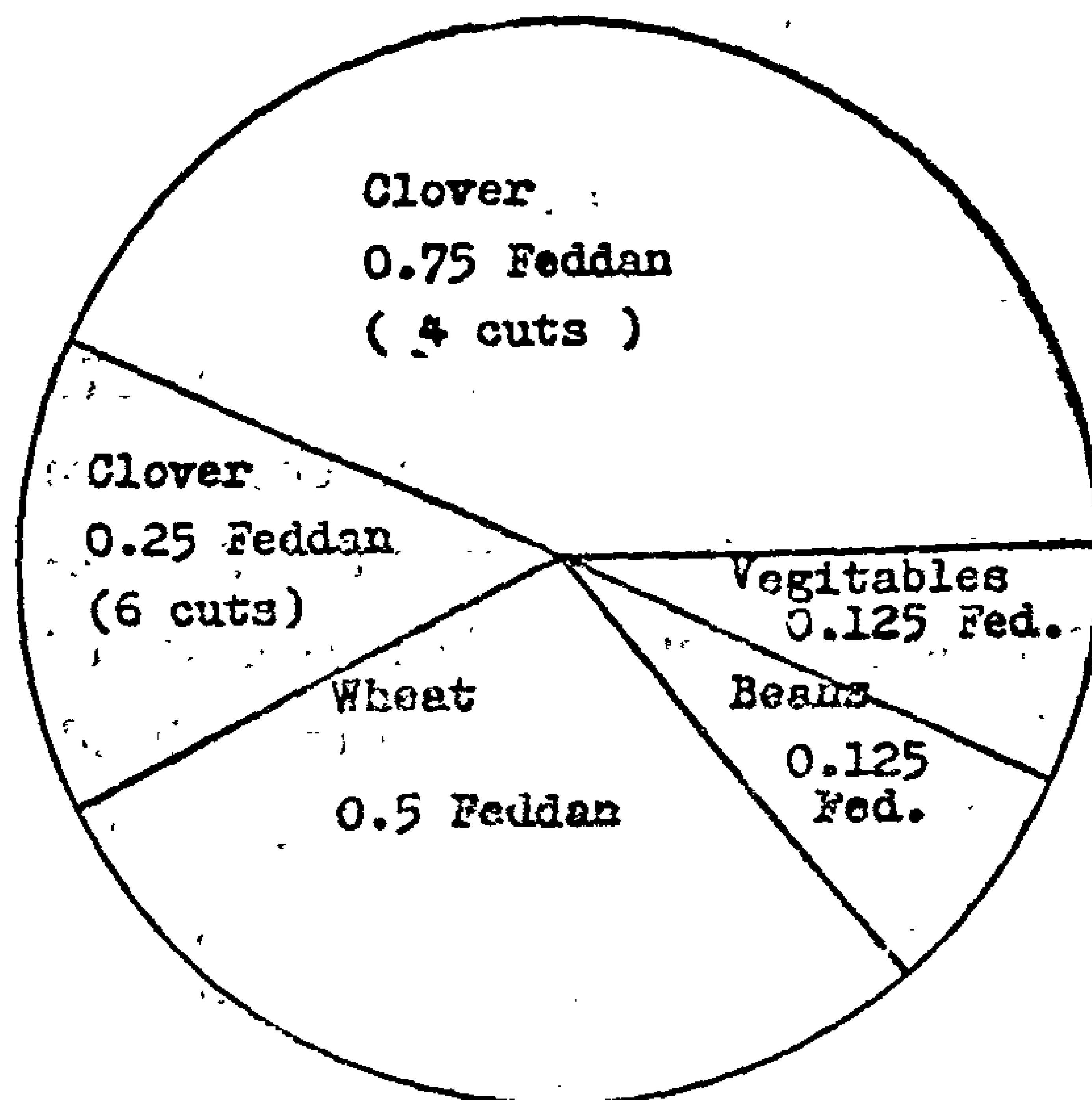


Fig. 4 b :





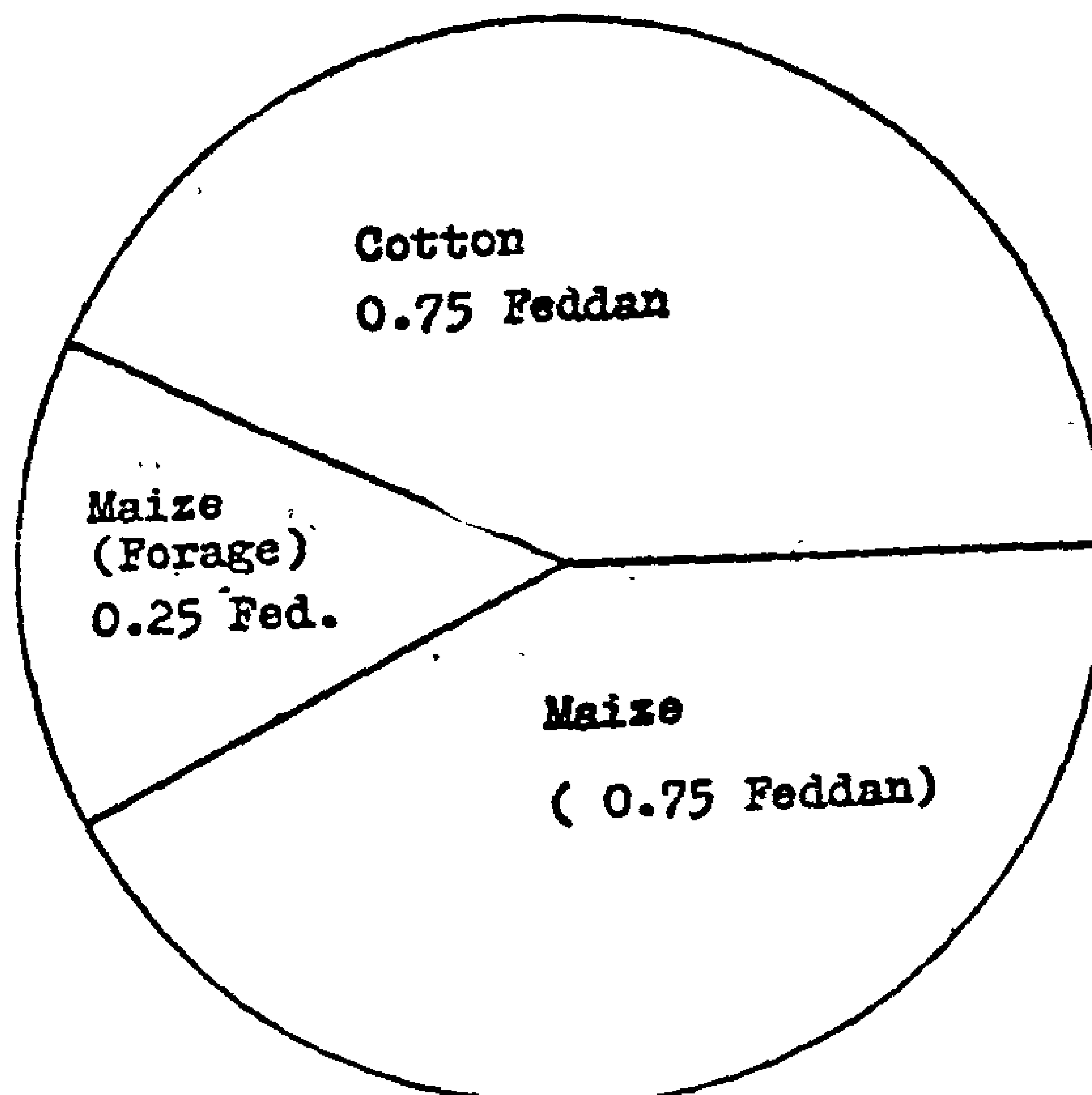


Fig. 2:

* Chemicals and fertilizers including nitrogen, phosphate.
* Organic fertilizers (Baladi).
* Planting.
* Harvesting.
* Threshing.
* Winnowing.
* Loading and transportation.
* Cleaning.

These can be grouped into more general area(3) of:

* Human labour with 716 kcal/hr rate.
* Animal labour of 2400 kcal/hr rate
* Organic residues left in the field.
* Seeds and planting.
* Mechanical operations including pumps, harvesting etc.

* Chemical fertilizers, including Nitrogen, phosphate as well as pesticides.

II.2. Results :

The results presented in figures (3) to (6) illustrated the energy inputs to the production of each of the four main crops Consdering the cropping structure shown in figure (2) and those of energy consumptions in figures (3) to (6), an overall energy scenario can be obtained. In figure (3) a), the energy consumptions to produce wheat are shown in case a sakia is used for irrigation. Chemical fertilizers and pesticides contribute to 48.45% of

non-commercial energy sector in Egyptian farm systems. Further, and contrary to the intended thrust of national agricultural policy decisions that have sought to displace clover (T. alexandrinum) as the number one crop (in terms of both area and dry matter yield), the work highlights the necessity of the crop livestock linkage in achieving maximum sustainable resource use and in broadening the rural economic base, particularly for women.

The present work seeks to identify opportunities for enhanced sustainability of energy resources available to the small farmer and to assist planners in estimating potential outcomes of pricing and production quota decisions at the macro level on agricultural energy demand and supply at the micro level. It is hoped that the methodology herein employed of attaining a more detailed understanding of the characteristics and needs of the small producer-the most common unit in Third World agriculture-may be helpful in designing and implementing policies that enhance indigenous food production capabilities and the quality of rural life.

II. ANALYSIS AND RESULTS :

II.1. Analysis:

The present work describes experimental, laboratory and field investigations in a selected representative area in the Delta in Egypt (1). Th selected zone consists of 2000 feddans (one feddan = 0.42 Hectare) in the village of Damhoug in Menofia governorate. The selected site in the present work was guided by the following two objectives;

1. Selection of governorates which reflect the agro-ecological, geographical and culture diversity of Egypt.

2. Selection of governorates of different levels of socioeconomic development.

In the first phase of work, only one village was selected with the primary goal of assessment of existing and future energy consumption pattarn and availa-ble ble energy sources to meet the needs of farm and domestic uses in rural Egypt. The methodology adopted utilized the following tools:

1) Field survey on agricultural farm and rural household to examine the energy sources and consumption rates.

2) Field measurements of agricultural energy consumption rates in driving pumps, tractors threshers etc through measurements of fuel consumption, water discharge rates etc.

3) Laboratory analysis of animal and crop residues and calculated values of embodied energies in fertilizers, chemicals, straws and product.

Figure (1) shows a simple small farm model for Egyptian Village farms in Damhoug. The focal point is the household with all input and output exchange with commercial sector, Livestock, crops and naturally the surrounding biosphere. Although this diagram looks simple and straight forward, nevertheless, many of the exchange rates are not known, difficult to assess or of uncertain magnitude. It can be seen from the model that four main crops were selected, these are : wheat, Maize, clover and cotton. The average typical cropping pattern of 1.75 feddan over the village is planted as shown in fig. (2).

The energy balances for the various four crops are shown in figures (3) to (6). For each crop, the following energy data were obtained from the field survey and questionnaires (2):

1) Typical energy inputs, namely:

* Irrigation considering boarder repair, pumping with sakia or diesel operated pump.

* Field preparation including plaughing, ramming etc.

ENERGY ANALYSIS IN IRRIGATED AGRICULTURE: A CASE STUDY

Dr. Essam Eldin Khalil

ABSTRACT:

An mportant ingredient to the efforts to improve agriculture productivity in Egypt is an effective and efficient utilization of available conventional energy sources for farm production and household consumption. This paper is essentially directed towards assessment of the important variables related to energy use and transformation in agriculture production. The present work is to promote efforts for more effective management and utilization of the limited energy resources in comprehensive agricultural strategies for Egypt's future.

Towards this end, the present work utilizes both survey questionnaire and field experimentation techniques to determine the quantitative energy use characteristics of production operations for cotton, wheat, Maize and clover.

The present paper describes the energy consumption pattern in a selected site at Damhoug, Menafia in the Nile Delta. The energy use by agriculture operation is estimated from the questionnarie and experimentation. The obtained results enhance the understanding of the characteristices and the needs of small farmer/ producer.

I. INTRODUCTION:

The research program analyzes the role of energy in agricultural productivity of an Egyptian village ecosystem, using engineering and socio-economic approaches. The object of analysis is the private sector, as exemplified by the household farm, in the context of a case-study village prototypic of the traditional cropping pattern in the Nile Delta region. The tradional system involves the allocation of commercial (fossil fuel-based) and non-commercial (biomass-based) energy resources in continous irrigated farming on a fixed land base among the primary food (wheat and maize), feed (clover, wheat straw and green maize) and fiber (cotton) crops, integrated with small-scale animal husbandry. The research will:

1. Disaggregate and quantify the renewable and non-renewable energy utilizazation and production patterns among the primary crops and livestock in the case-study village.

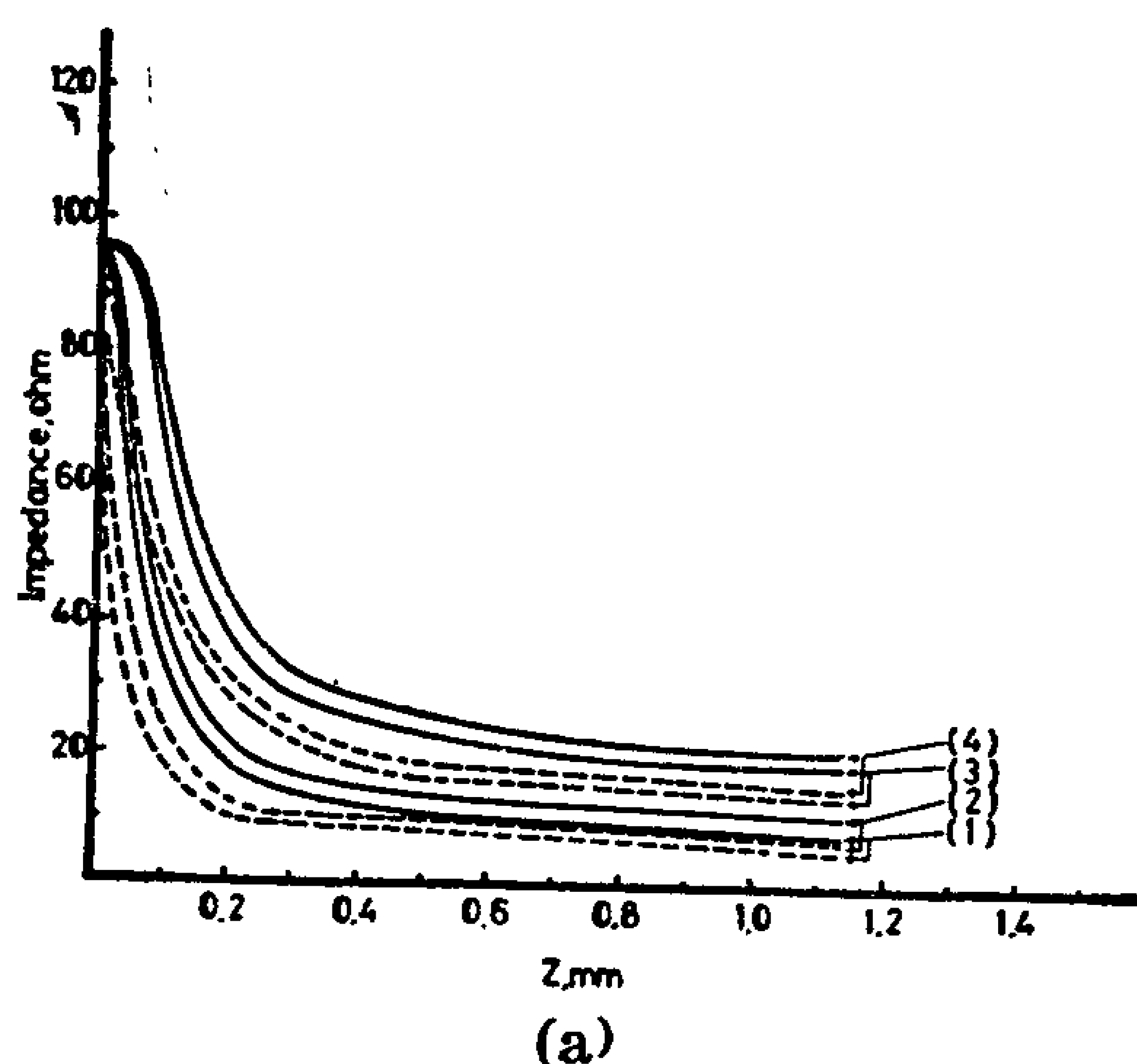
2. Develop means for comparing farm-level energy demands of alternative, and qualitatively dissimilar, conversion mechanisms that are based on machine-, animal-, and humandriven technologies; (primary activities requiring technology choice include irrigation, harvesting and postharvest processing); and

3. Develop a simulation model that will be designed to compare the energy demand and supply characteristics of alternative crop-livestock production scenarios and to evaluate the implications of such characteristics for food-and particularly protein-self-sufficiency of the rural household.

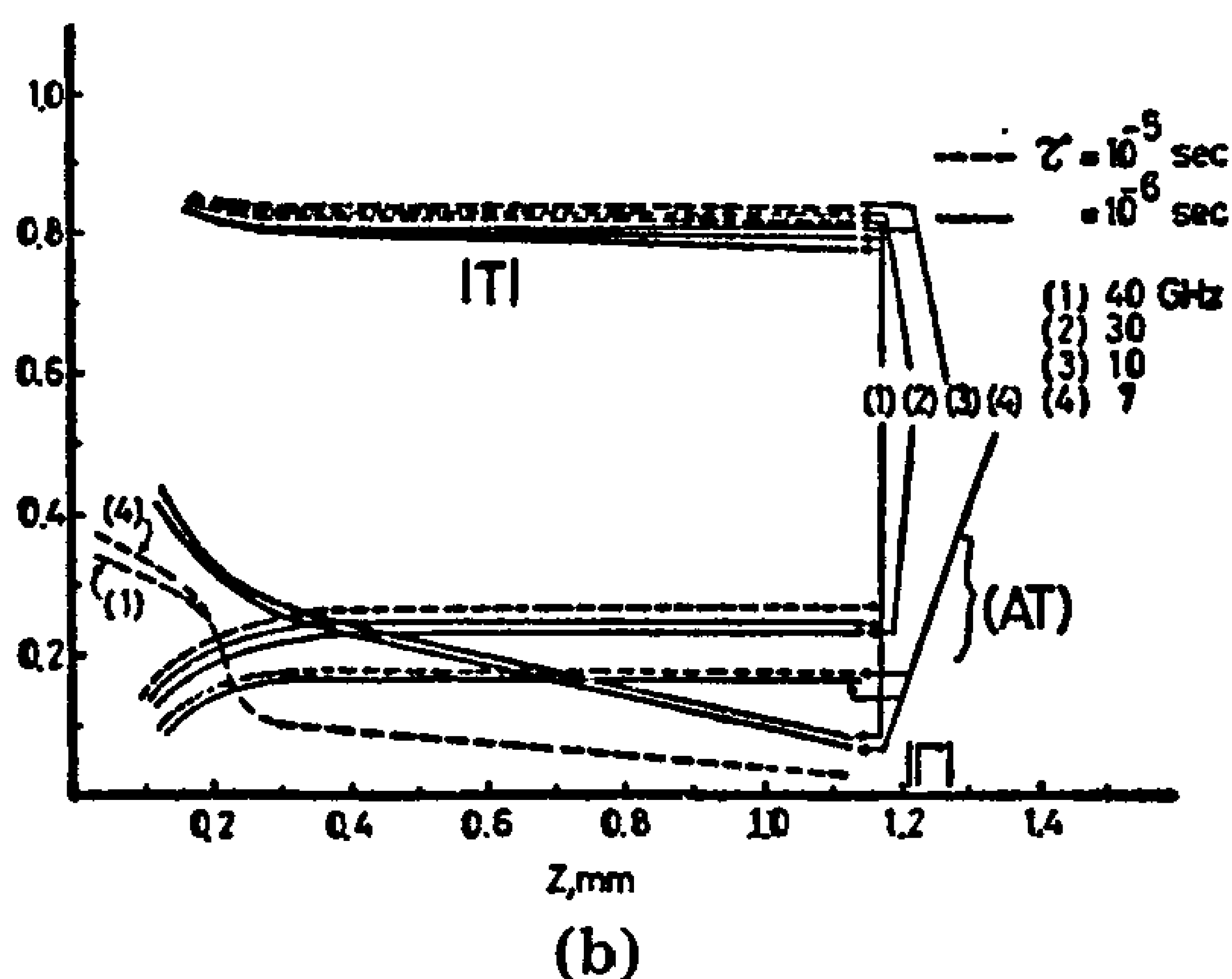
To date, the work has underscored the heretofore unquantified importance of the

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At $\tau = 10^{-4}$ sec, the attenuation for the same frequency band is from 35-40% and reflections are relatively small (fig. 4) Sample which have $\tau = 10^{-5}$ sec. will reduce the attenuation ratio to 22-25% and matches from 110 to 15 ohms, while samples of $\tau = 10^{-6}$ sec matches between 90 to 20 ohms with approximate power transmission of 70%. thus optoelectronic microwave tapers and attenuators are deduced. Obtaining optoelectronic phase shifters will be discussed in another future work.



(a)



(b)

Fig. 5 : (a) Profiles for the Reflection and Transmission Coefficients and Attenuation Througm Germanium Layers, and (b) Wave Impedance

Conclusion :

At last, we come to the conclusion that the process of carriers diffusion in a laser lightened semiconductor, at different levels of power excitation can be used for controlling purposes of a microwave signal. Obtaining the distribution of the longitudinal conductivity σ (Z) is very important to evaluate the reflection, and transmission coefficients of signals. The semiconductor parameters, the laser source power and the physical conditions of the used material affects the distribution of conductivity and consequently the mirowave signal behaviour. This simple optoelectronic technique has useful applications for obtaining tapers, attenuators and phase shifters

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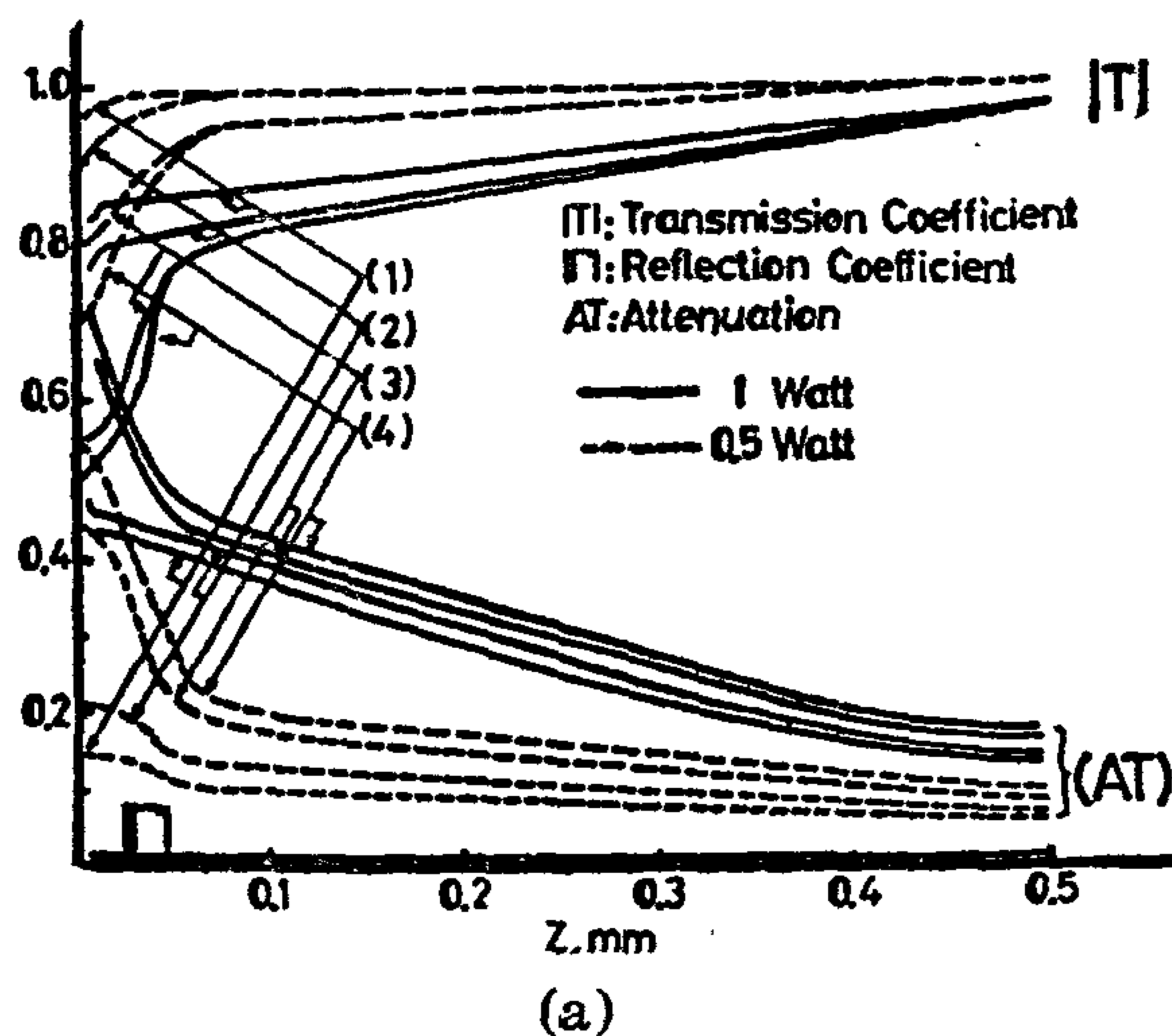
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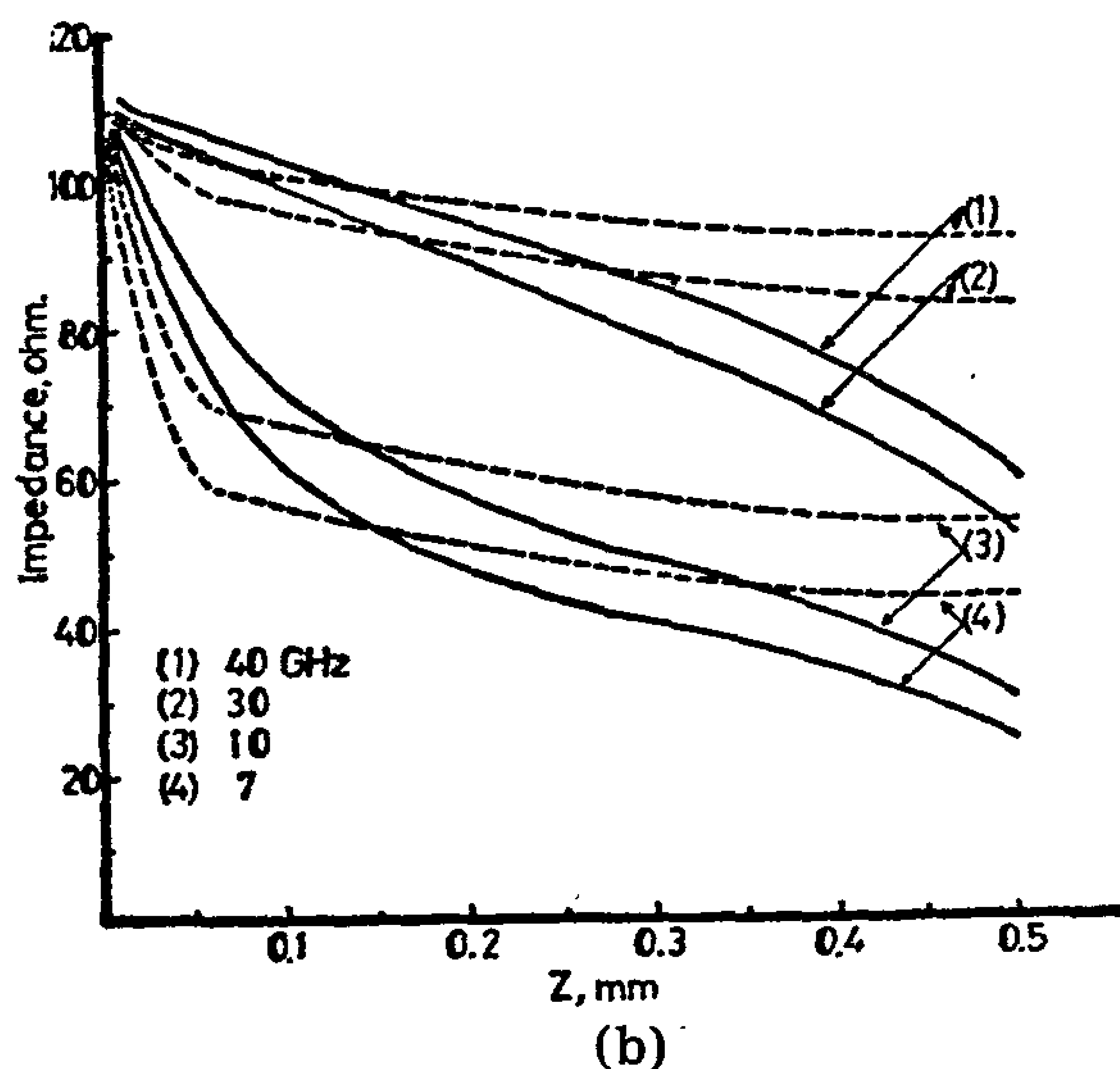
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illustrates the prifiles of the reflection, transmission and attenuation coefficients for a Si radiated layer by laser at different power levels. The effect of frequency variation is studied and it is clear that the behaviour of microwave signal is stable within a waveguide frequency band. The deviations of transmission, reflection and attenuation coefficients due to frequency variation (30-40GHz) is very small. The applied laser power, material parameters and physical conditions have considerable eeffect on the σ (z) distribution and consequently on the microwave signal behaviour. For example the signal is better transmitted when the Si sample is radiated by 0.5 watt laser source than that of the higher power case (at the band from 30-40 GHz). The 0.5-watt Si radiated sample works as a lossy taper which matches between 110 to 90 ohms with power delivery about 85%. On the other hand the 1-watt radiated Si layer works as a taper from 110 to 70 ohms with higher loss ratio, or as an attenuator of about 33% attenuation coeficient. Variation of the waveguide frequency band (X-band) will affect the response of signal as shown in figs. 3a and ab. within the Si sample the reflections in all cases are very small (of the order 0.02). For Ge sample at temperature higher than 300° K or at lifetime = 1 m.sec. the line acts as a lossy taper from 95 to 10 ohms with power loss about 40-45% at the frequency band (30-40GHz) (fig. 4).

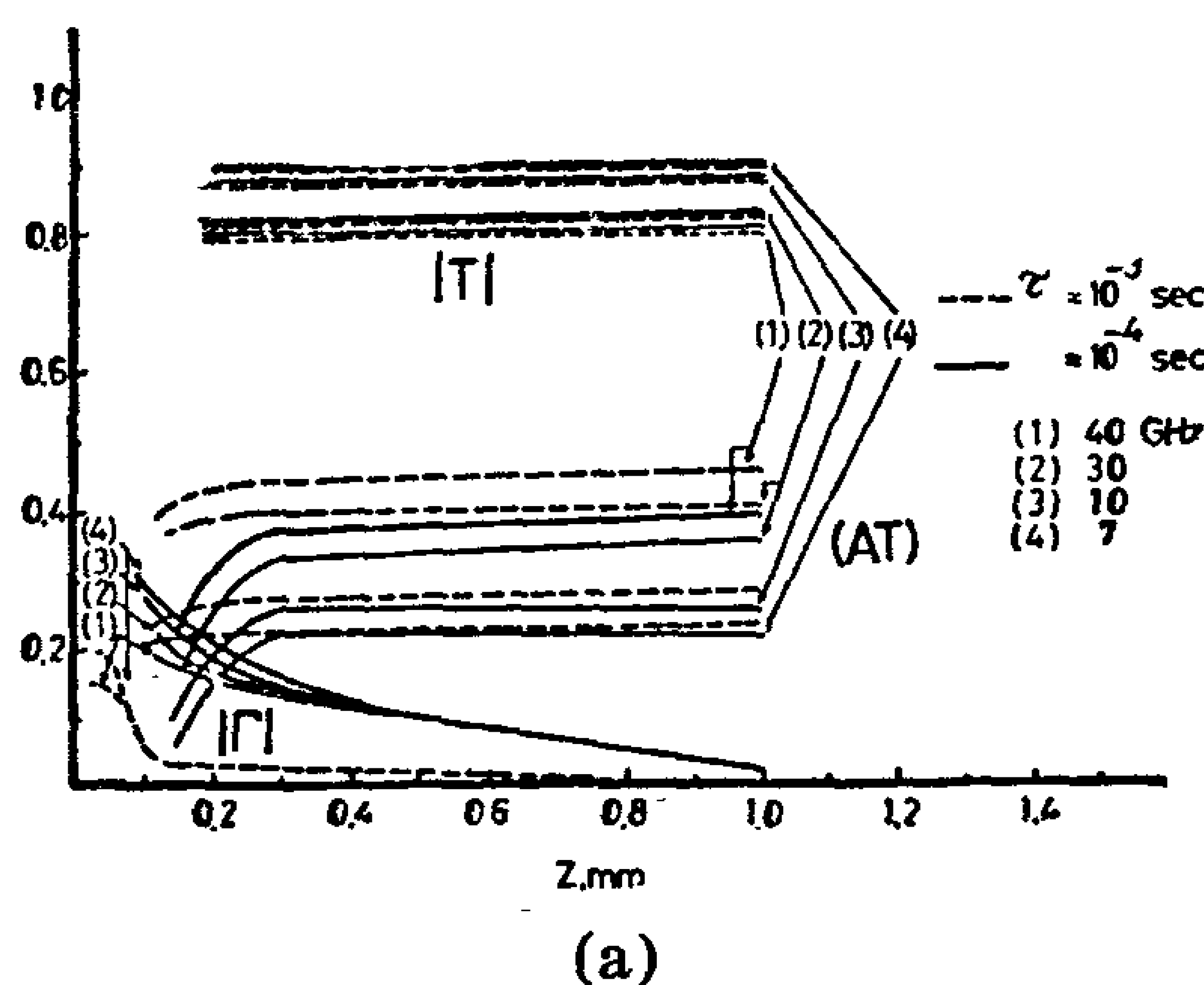


(a)

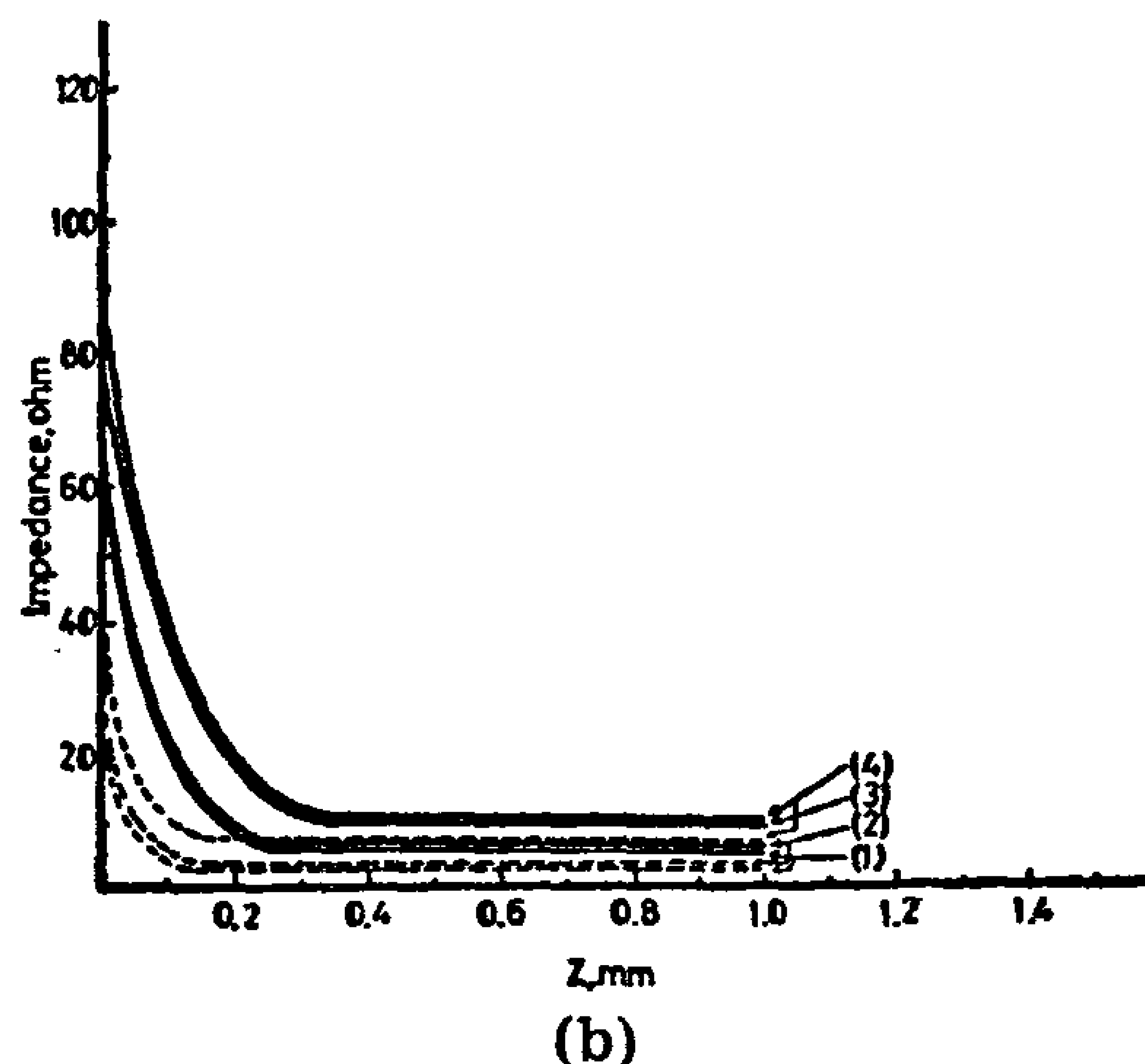


(b)

Fig. 3 : (a) Profiles for the Reflection and Transmission Coefficients and Attenuation Through Silicon Layers, and (b) Wave Impedance



(a)



(b)

Fig. 4 : (a) Profiles for the Reflection and Transmission Coefficients and Attenuation Through Germanium Layers, and (b) Wave Impedance

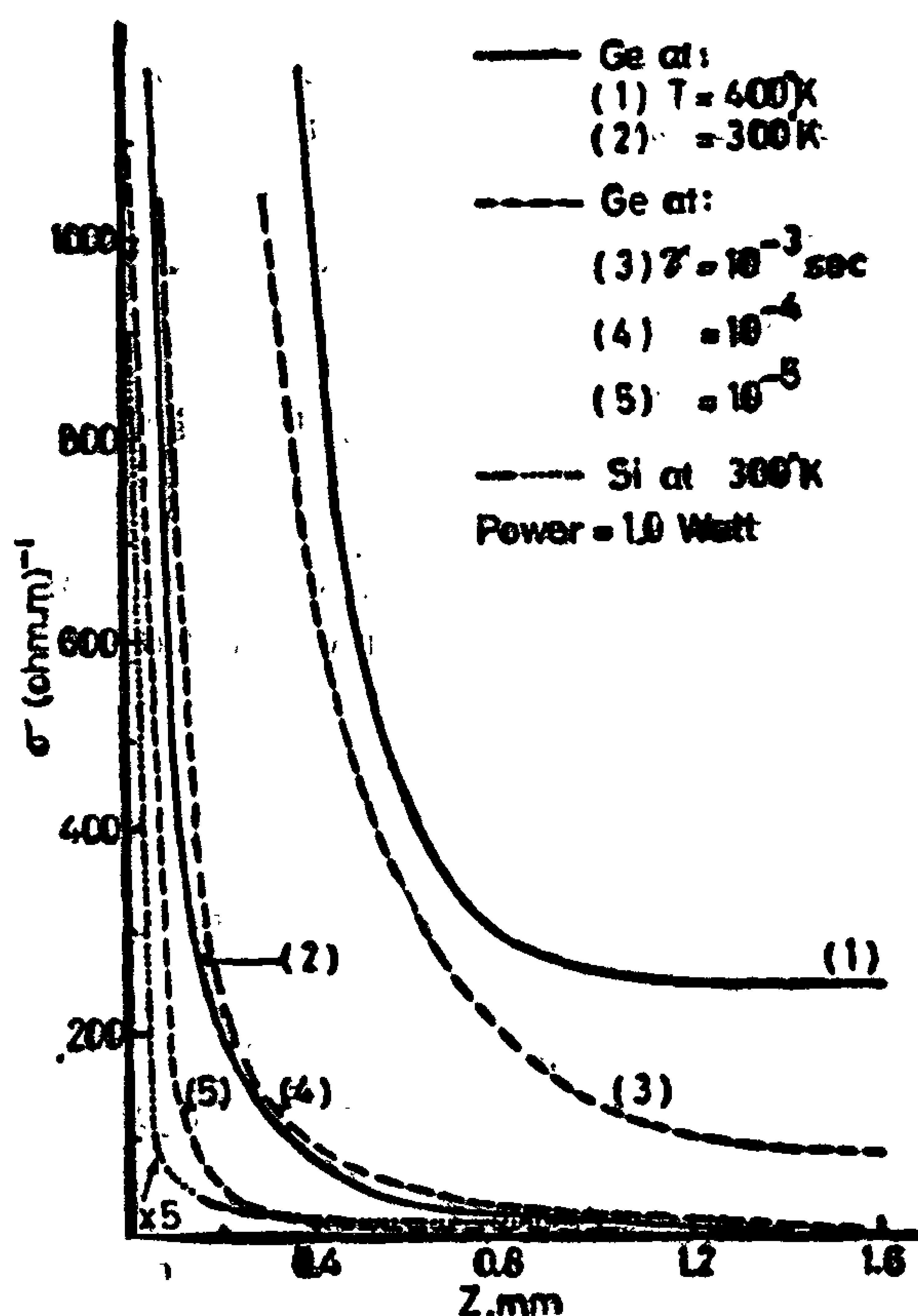


Fig. 2 : Longitudinal Conductivity Distribution Along the Photoexited Silicon and Germanium Layers

The wave impedance (Z_j) for the sublayer j is;

$$Z_j = 377\ (C + iD)$$

$$C = \frac{((a)^{\frac{1}{2}} + C_j)^{\frac{1}{2}}}{(2a)^{\frac{1}{2}}}$$

$$D = \frac{((a)^{\frac{1}{2}} - C_j)^{\frac{1}{2}}}{(2a)^{\frac{1}{2}}} \qquad (8)$$

$$a = \epsilon^2_{\gamma j} + \epsilon_j{}^2$$

$$\epsilon_j = \epsilon_{rj} - (\lambda_o / \lambda_c)^2$$

$$\epsilon_{\gamma j} = -\sigma_i / w\epsilon_o$$

where ε_j and ε_o are the relative permittivities for layer j and free space respectively, and w is the operating radial frequency. λ_o and λ_c are the free space and cutoff wavelengths respectively.

On the other hand, the input impedance transmission coefficient and the reflection coefficient at the interface between two successive layers j and j+1 are given by (7) :

$$Z_{in}(j+1) = Z(j) \frac{Z_{in}(j) + Z(j)\tanh \gamma_j d_j}{Z(j) + Z_{in}(j)\tanh \gamma_j d_j} \qquad (9)$$

$$\frac{T_j}{T_{j+1}} = \frac{Z_{in}(j) + Z(j)}{Z_{in}(j) + Z(j+1)}\, e^{-\gamma_{j+1} d_{j+1}} \qquad (10)$$

$$\Gamma_{(j+1)} = \frac{Z_{in}(j) - Z(j+1)}{Z_{in}(j) + Z(j+1)} \qquad (11)$$

where

$\gamma_j = \alpha_j + j\beta_j$ **is the propagation constant**

$$\alpha_j = \frac{4.443}{\lambda_o} \left((a)^{\frac{1}{2}} - \epsilon_j \right)^{\frac{1}{2}}$$

$$\beta_j = \frac{4.443}{\lambda_o} \left((a)^{\frac{1}{2}} + \epsilon_j \right)^{\frac{1}{2}}$$

The attenuation Coefficient is then calculated by :

$$AT_j = 1 - T_j T_j^* - \Gamma_j \Gamma_j^* \qquad (12)$$

The microwave response using the above multilayered analysis is studied for Si and Ge under different conditions. Fig. 3a

$$\frac{dn(z,t)}{dt} = U_e(z,t) - U_{re}(z,t) + \frac{1}{e}\,\mathrm{div}\, J_e$$

$$\frac{dp(z,t)}{dt} = U_h(z,t) - U_{rh}(z,t) - \frac{1}{e}\,\mathrm{div}\, J_h \quad (1)$$

Wnere; U_e, U_e stand for tne generation terms of electrons and holes respectively, and U_{re}, U_{rh} stand for carriers recombination.

$\frac{1}{e}$ div $J_{e,h}$ is the change of carriers concentration due to the flow of currents.

The current components are:

$$J_e = en\mu_e E + eD_e \frac{dn}{dz}$$

$$J_h = ep\mu_h E - eD_e \frac{dp}{dz} \quad (2)$$

Where: e is the electron charge,
U_e, U_e are carriers mobilities,
D_e, D_h are their diffusion coefficients
$\bar{E}$ is the inner electrostatic field

In the case of high level photo-injection considering electron-hole pair generation with radiative recombination (7), the recombination term can be shown to be :

where:

$$U_r(e,h) = \Delta n^2/(n_o+p_o)\tau + \Delta n/\tau \quad (3)$$

ΔP and Δn are the changes in carriera concentration, n_o and P_o are their balanced original concentration. is the carriers lifetime

Substiting (2) and (3) in (1) and considering the steady state case (when $t \gg \tau$ then dn/dt, dp/dt $\simeq$ 0), one can get the equations that describe the behaviour of electrons and holes. After some manipulation one diffusion equation for both electrons and holes is deduced.

$$D\,\frac{d^2(\Delta n)}{dz^2} = \frac{(\Delta n)^2}{\tau(n_o+p_o)} + \frac{(\Delta n)}{\tau} - U_o e^{-\alpha} \quad (4)$$

$\Delta n = \Delta p$, $D = D_e D_h/(D_e+D_h)$, $U_e = U_n = U_o e^{-\alpha z}$

α is the optical absorption coefficent of the material. Eq. 4 is numerically solved using the boundary conditions :

$$\Delta n(z)\Big|_{Z \gg Ld} = 0 \quad , \frac{d\Delta n(n)}{dz}\Big|_{Z \gg Ld} = 0 \quad (5)$$

Where $Ld = (\tau D)^{\frac{1}{2}}$ Ld is the diffusion length of the carriers

The longitudinal conductivity σ (z) may then be evaluated from the equation:

$$\sigma(z) = e\left[(n_o + n(z))\mu_e + (p_o + p(z))\mu_n\right] \quad (6)$$

Figure 2 illustrates the (z) distributions along the photoexcited layers of silicon and Germanium. Effect of varying the temperature and lifetime on the distribution of σ (z) are also shown.

The obtained inhomogeneous distribution of σ (z) will greatly effect the function of the waveguide. These optical system can be used as a new technique for building microwave components such as attenuators, tapers, etc.

Microwave Applications :

The excited semiconducting layer is fitted in a rectangular waveguide in which the dominant mode of propagation is TE 10-Mode. The inhomogeneous layer is divided into N-homogeneous sublayers, each has an average value of conductivity of

$$\sigma_j = \frac{\sigma_{j+1} + \sigma_{j-1}}{2} \quad (7)$$

OPTOELECTRONICS FOR MICROWAVE COMPONENTS

Moataza A. Hindy and Fouad A.S. Soliman

Abstract :

This paper describes simple techniques to optically control microwave signals and to build new controlling components. The quasimetallic photo-conductivity produced by the absorption of optical signals in semiconductor has been analyzed and the generated conductivity profiles are obtained. These plasma profiles are functions of the applied laser power, material parameters and temperature. The effect of these profiles on the microwave signals is studied and relations between the optoelectronic plasma and the microwave signal are deduced.

Introduction:

In the last few years optically controlled microwave signals occupied attraction specially for building high speed microwave optoelectronic switches [1-5]. Laser controlled components are simple in operation and have high precision as well as complete isolation between the optical and microwave signals is achieved. Analysis of the high level photo-injection and semimetallic induced conductivity was not given serious consideration. The application of these high density plasma in a waveguide was not studied previously. The semiconductor layer is fitted in a waveguide as shown in Fig. 1. The layer is photoexcited by a laser source. An exponential decay of photoconductivity across the longitudinal section of semiionductor layer forms a laser induced electron-hole plasma, a wedge that works as a lossy tapered transmission line, attenuators and phase shifters.

Optoelectronic Analysis :

When a photoradiated energy is applied on a semiconductor material the concentration and distribution of free carriers are changed. This change depends on the radiated power, the direction of radiation, the parameters of the semiconducting material and its physical conditions. If the optical signal is homogeneousely applied normal to the plane $Z=0$ as shown in Fig. 1, the conductivity profile will be a function of the Z-axis and time. If n an p denote the resultant concentration of electrons and holes respectively then the equations describing their rate of change are [6] :

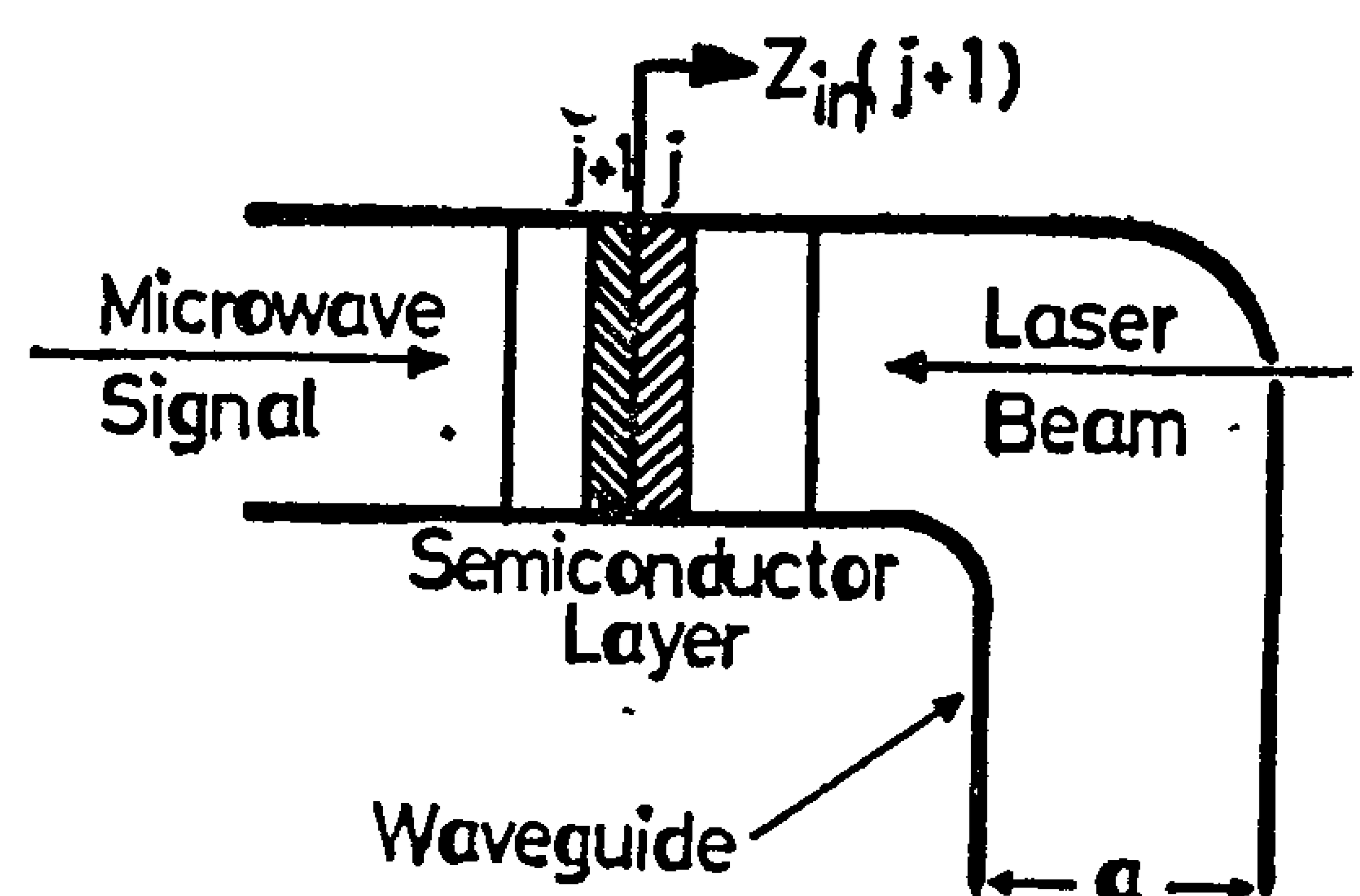


Fig. 1: Method for Controlling Microwave Signals Using Laser Beams.

National Research Centre, Electronics Research Institute Dokki, Cairo, Egypt.
Nuclear Materials Corporation, Cairo, Egypt.

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ANALYSIS

Table (1) Land

Subject		A	B	C	D
a- Housing area	%	56.--	58.--	59,--	64,--
b- Scholls and play grounds	%	17.--	15.--	15.--	14.--
c- Shopping centre	%	2.5	2.5	3.--	6.--
d- Garage	%	0.8	1.2	1.8	----
e- Open spaces and streets	%	23.7	23.3	21.2	16.--
Total	%	100.--	100.--	100.--	100.--

- Land use

Table (2) Densities

S U B J E C T	A	B	C	D
1- Housing area - hectare	8.80	9.20	9.32	10.10
2- Population - number	6,637	4,596	4,690	4,820
3- Gross density inhabitants/hectare	422	292	298	307
4- Net residential density inhabitants/hectare	755	500	534	480
5- Total rooms	4,977	3,447	3,517	3,615
6- Accommodation density rooms/hectare	565	375	378	360
7- Housing built-up area sq.m.	8,110	15,154	10,584	20,304
8- Housing built-up area%	20	16	11	20
9- Housing floor area sq.m.	119 232	59,904	97,632	97,632
10- Average floor number	8 9	9.6	5.7	
11- Floor space index "F.S.I."	1.35	1.1	1.1	0.97

- Densities

Garages and Parking places :
20% = 960 places
Under ground garages for 900 cars
Parking places for 60 cars

Neighbourhooh area = 15.7 hectares

Gross density = 307 inhabitants per hectare.

Fig. (4-a) The Neighbourhood Unit Plan (D)

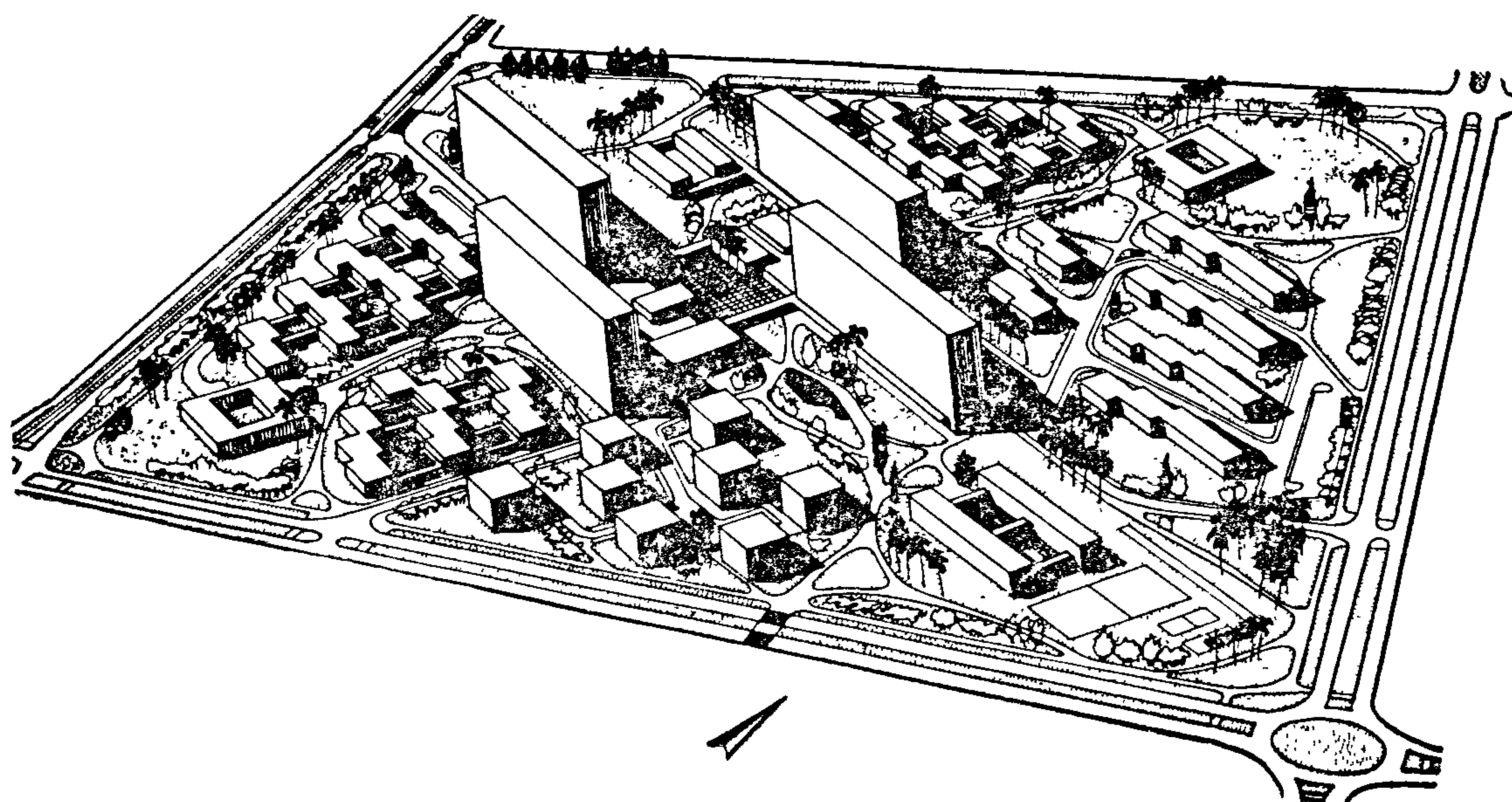


Fig. (4-b) Air View For Plan (D)

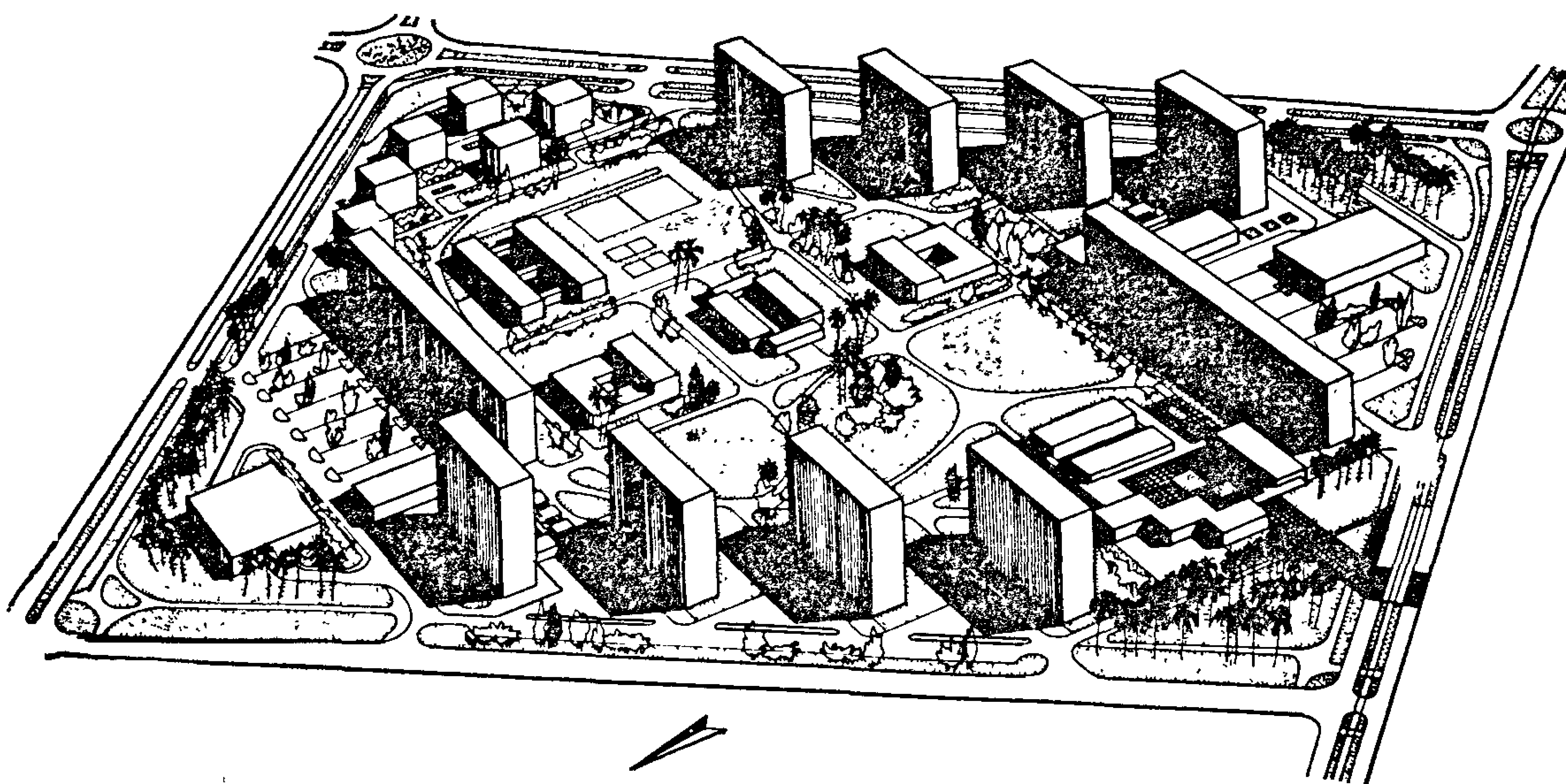


Fig. (3-b) Air View For Plan (C)

Kindergarten:

4% = 93 children, say 90 children
Area erguired is 0.27 - 0.36 hectare
Total number of inhabitants in the two house groups:

Nuresery :

2% = 94 children.

Area required is 0.30 hectar

Elementary school:

14% = 660 pupils, class-room of capacity 32 pupils, i.e. number of class-rooms = 21

Garages and parking places :

20% = 940 places
From which 40% garages = 370 cars
60% parking = 570 cars

Area required for parking is about 1.44 hectares

Neighbourhood ares = 15.7 hectares
Gross density = 298 inhabitants per hectare.

4- PLAN - D

This plan has the diagonal composition with its long four 12-storey flat bulldings, 4-storey and 2-storey houses. Fig.(4).

The main difference between this plan and the last three plans is that, sub. centres are joined together with the shopping centre in one area.

a- House Group 1:

12- storey	1,770 inhabitants
4-storey	410 inhabitants
2-storey	360 inhabitants
Total	2, 540 inhabitants

Kindergarten
4% = 100 children,
Area required is 0.3 - 0.4 hectare

12- storey	1,770 inhabitants
2-storey	510 inhabitants
Total	2,280 inhabitants

Kindergarten :

4% = 91 children say 90 children
Area required is 0.27 - 0.36 hectare
Total number of inhabitants in the two house groups :

2,540 + 2,280 = 4,820 inhabitants

Nursery :

2% = 96 children say 100 children
Area required is 0.3 hectare
Elementary school :
14% = 675 pupils, class-room of capacity 32 pupils, i. e. number of class-room of = 21.

Garages and parking places:

20% =920 places

From which 40% garages = 370 cars
60% parking = 550 cars

Area required for parking is about 1.37 hectares

Neighbourhood area = 15.7 hectares
Gross density = 292 inhabitants per hectare.

... 3 — PLAN-C

There are two groups on the contary the last two plans A and B, having 12-storey and long 8-storey flat buildings plotted diagnally «Fig. (3)».

Data: ...

(b) **House Group 1:**

12-storey	1,500 inhabitants
8-stotey	665 inhabitants
4-storey	180 inhabitants
Total	2,345 inhabitants

Kindergarten:

4% = 93 children.
Area required is 0.27 - 0.36 hectare

(b) **House Group 2:**

12-story	1,500 inhabitants
8-storey	665 inhabitants
4-storey	180 inhabitants
Total	2,345 inhabitants

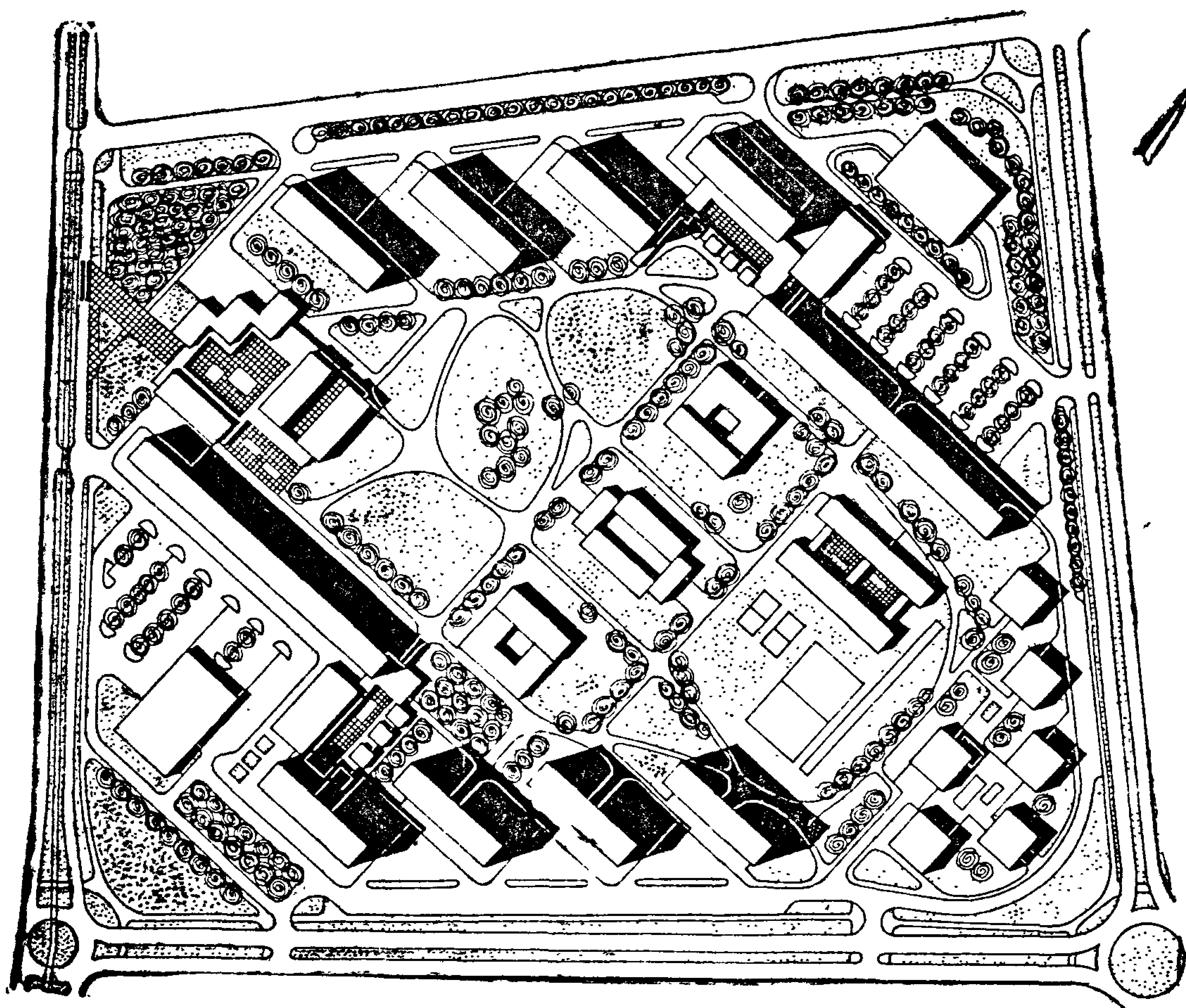


Fig. (3-a) The Neighbourhood Unit Plan (C)

Fig. (2-a) The Neibourhood Unit

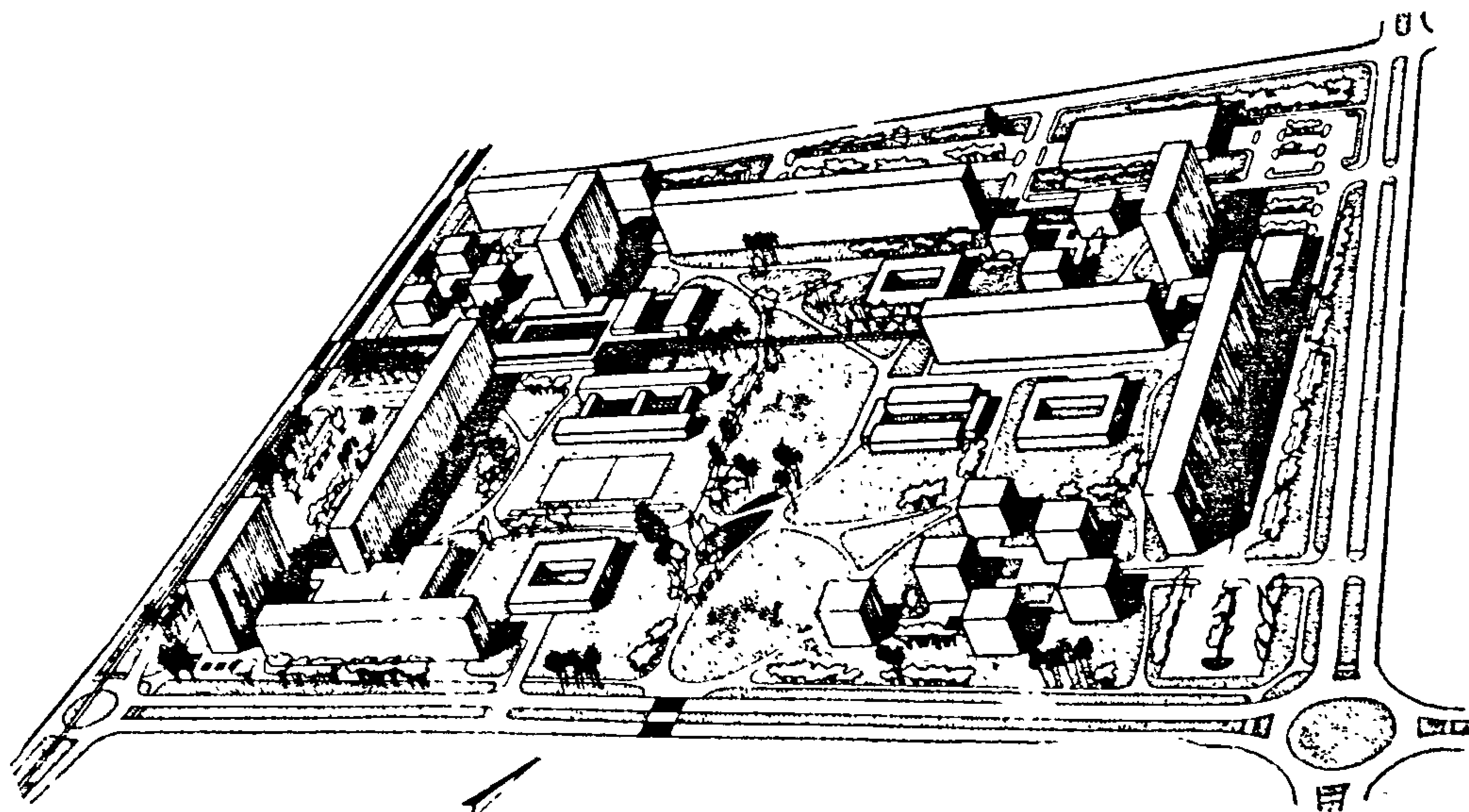


Fig. (2-b) Air View For Pan (B)

(c) House Group 3:

12-storey	1,480 inhabitants
6-storey	914 inhabitants
Total	2,394 inhabitants

Kindergarten:

4% = 96 children,

Area required is 0.30 — 0.40 hectare
Total number of inhabitants in the three house groups:

2.578 + 1,665 + 2394 inhabitants

Nursery: Number of childen for nursery school is calculated by the percentage of 3%, 2% and 1.4%. the chosen percentage in this and the next three plans is of 2%.

2% = 133 children, say 140 children
Area required is 0.4 hectars.

Elementary school :

14% = 930 pupils, class-room of capacity 32 pupils, i.e. number of class-rooms = 29.

Garages and parking places :

These two elements are claculated as 20% = 1,326 places.

From which 40% garages = 530 cars
60%parking = 797 cars

Area required for parking is about 2 hectares.

Neighbourhood area = 15.7 hectares.

Gross density = 6,637 + 422 inhabitants per hectare.

2 — PLAN-B

This design contents of three house groups which their sub-centres are closed to the kindergarten. The school system for the elementry school, kindergarten and the nursery is sited closed to the central green area. The garage is in the northern corner of the residential unit as a whole "Fig. (2)".

Data :

(a) **House Group 1:**

12-storey	375 inhabitants
8-storey	665 inhabitants
6 storey	312 inhabitants
4-storey	180 inhabitants
Total	1532 inhabitants

Kindergarten:

4% = 63 children.

Area required is 0.18 - 0.24 hectare

(b) **House Group 2:**

12-Storey	375 inhabitants
8-storey	665 inhabitants
6-storey	312 inhabitants
Total	1532 inhabitants

Kindergarten:

4% = 54 children.

Area required is 0.18 - 0.24 hectar

(c) **House Group 3:**

12-storey	375 inhabitants
8-storey	665 inhabitants
6-storey	312 inhabitants
4-storey	360 inhabitants
Total	1,712 inhabitants

Kindergarten:

4% = 68 childen.

Area required is 0.27 - 0.36 hectare
Total number of inhabitants in the three house groups: 4776 inhabitants

Nursery:

2% = 92 children.

Area required is 0.30 hectare

Elementary school:

14% = 645 pupils, class-room of capacity 32 pupils, i.e. number of class-room = 20

Fig. (1-a) The Neighbourhood Unit Pan (A)

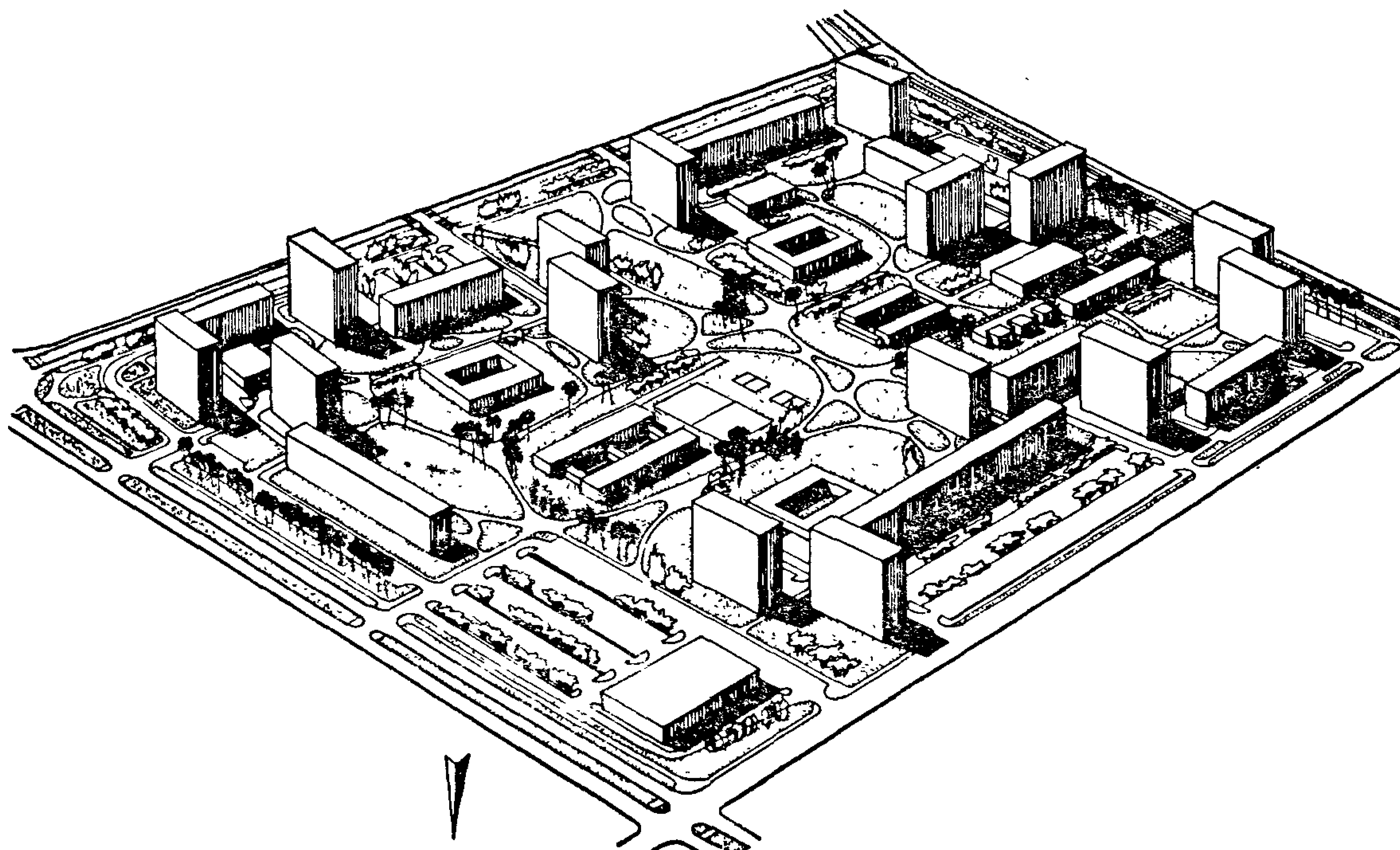


Fig. (1-b) Air View For Plan (A)

PLANNING THE NEIGHBOURHOOD UNIT

Dr. Abd El Naby Askar

PLAN-A

The whole area of theis neighbourhood is 15.7 hectares, containing three house groups «Fig. 1».

Each group of houses has its kindergarten which is for children between three and six years old, sub-centre for daily services like loundry, repairing and maintentenance shops, small meetings clubs., also some shops for groceries, vegetables, cakes, meat, fish. tobacco and newspapers.

The neighbourhood shopping center is located near the main traffic ready to give dwellers the possibilities to make shopping during their return bak home journey from work. After shopping by their way back home they can company their children. The shopping centre contains three sections, one of them being grocery, small restaurant and a vegetables and fruit shop. The second has the main services, cleaning clothes, barber. tailer and repairing shoe. In the third there is the club with its library. meeting hall connected with a small buffet. By the third' a youth club may be found.

The nursery school which is for babies from four months to three years of age is in the central green area near the primary school for children who are between six and eleven years of age.

From first principles, there is no place for the garage in the neighbourhood unit, where it is sited at the northern edge of the residential area.

Parking areas are spreaded outside towards edges while the central area is for pedestrians only.

Green Areas:

Green areas are of four types.

1 — Green belt between communications and parkimng areas which is a filter for residential houses from dusty wind.

2 — Group of houses green belt on the recreation place for young children, who are under school-age.

3 — Neighbourhood green area which is tight or attached with group houses This system allows pedestrians to pass through its centre.

4 — Schools green areas which are good recreation places for children during school day with their play fields.

Technical data:

(a) House Group 1:

12-storey	1,498 inhabitants
6-storey	1,080 inhabitants
Total	2,578 inhabitants

Kindergarten:

4% = 103 children.

Area required is 0.36 — 0.48 hectars

(b) House Group 2:

12-storey	1,000 inhabitants
6-storey	665 inhabitants
Total	1,665 inhabitants

Kindergarten:

4% = 67 children.

Area required is 0.20 - 0.26 hectare

a linear optimization technique. The design charts presents the optimum weight of a portal steel frame and the optimum cross-sectional areas for both rafter and column for different spans and spacing. These are given in Figures 2 throught 5. In addition, the results lead to the following conclusions;

1 — The optimum cross sectional area of a column for spans less than 17 ms is bigger than the required for rafter. Whereas in cases of spans bigger than 22 ms the optimum cross sectional area of rafter is bigger than that required for a column.

2 — In cases of spans variation between 17 ms to 22 ms. the optimum cross sectional areas of rafter and column may be chosen equal according to Figure 5.

3 — Case of dead and live load (Case A) governs the design of column and reafter for all spans and spacing of portal frame.

4 — The weight of portal frame is less than that of pitched roof frame with slopes 20% and 50% only for spans less than or equal to 13 ms. or 16 ms. respectively.

5 — The choice of pitched roof frame instead of portal frame has an increasing justification with the increase of span.

— This study is limited to spans vary between 12 ms to32 ms, the clear height of frame is constant and equal to 6.0 ms the spacing between frames varied between 4.0 ms to 10 ms, the section of frame members are assumed to be I.P.E. sections, and the material of construction is normal mild steel (Steel 37).

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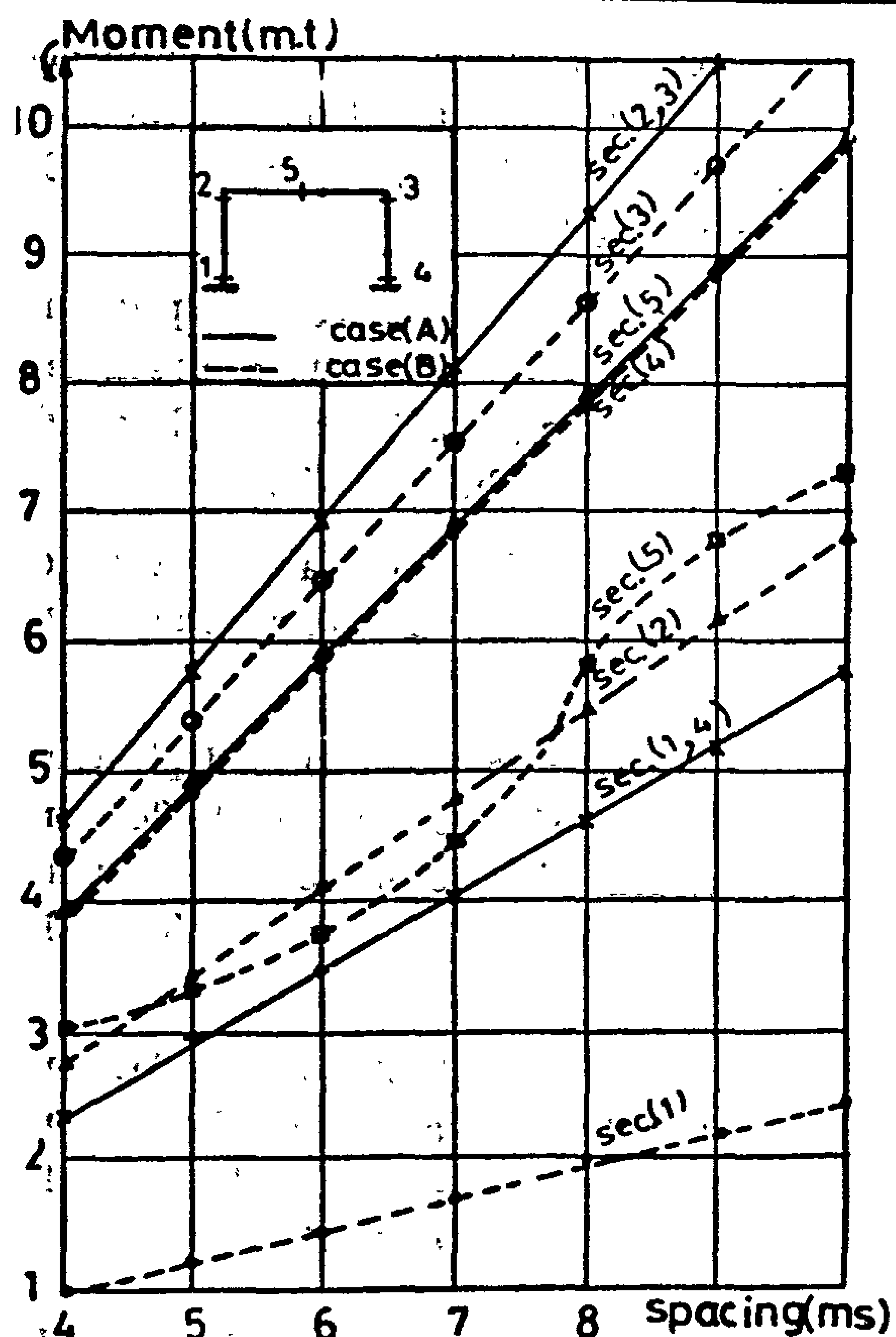
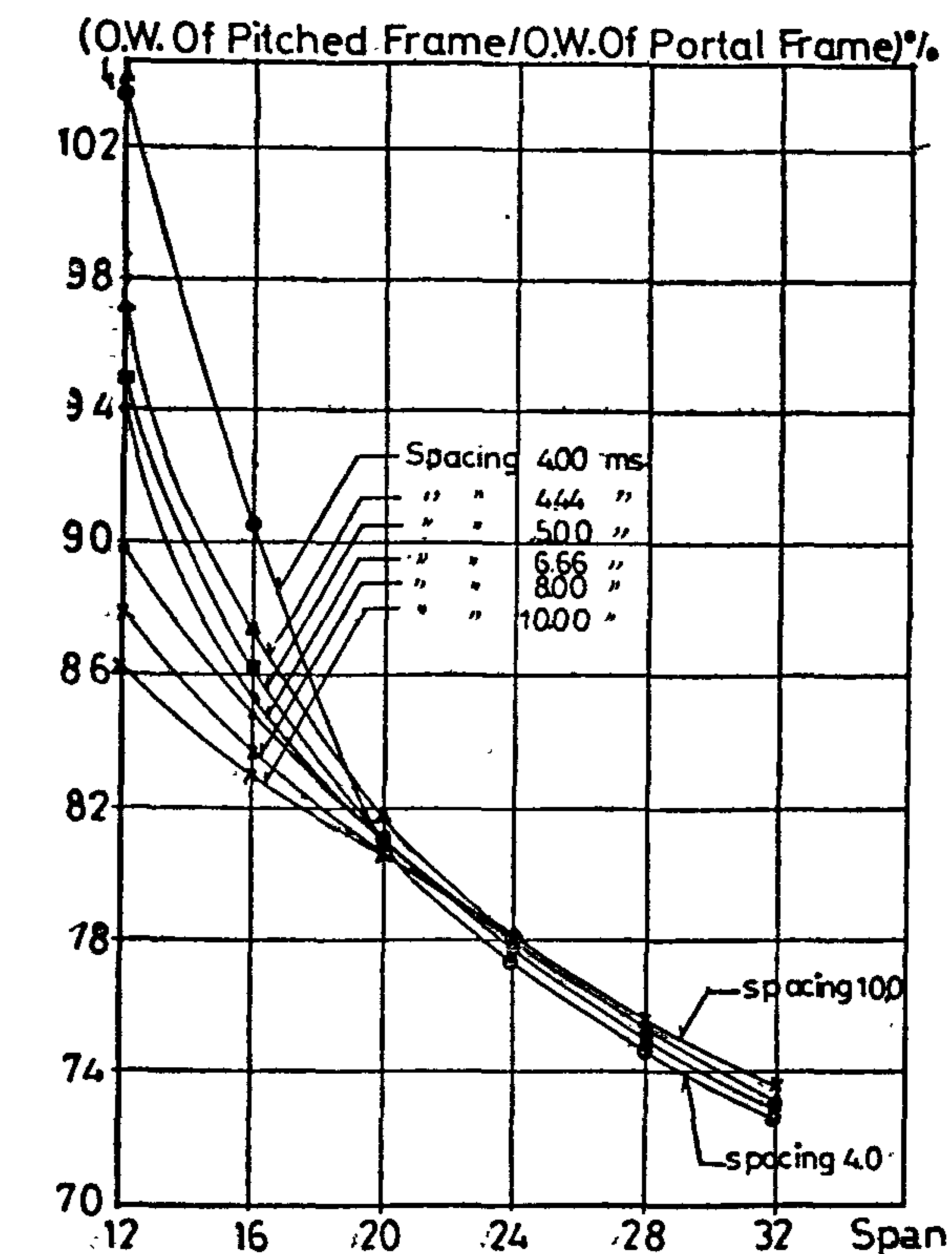
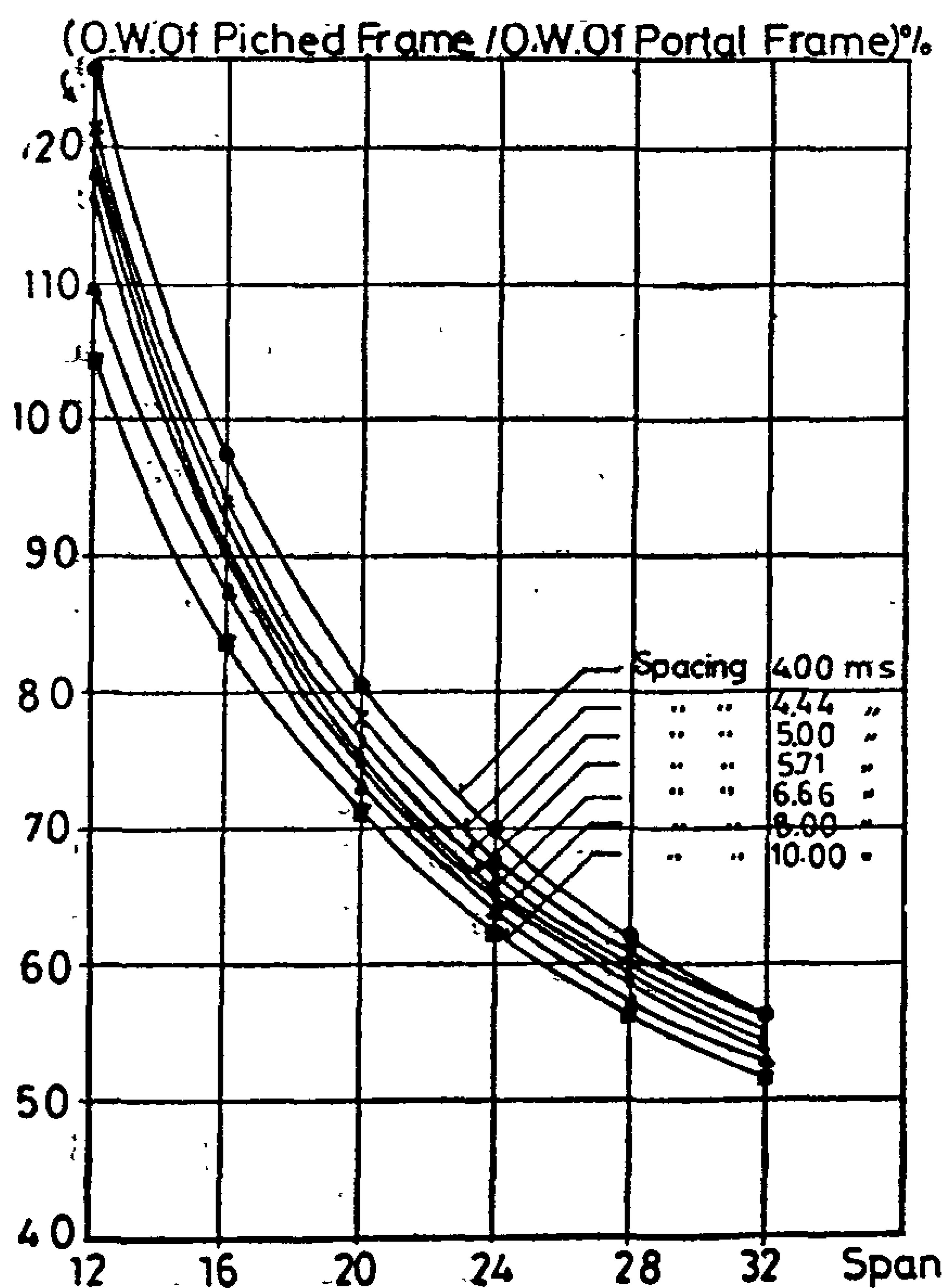


Fig.(7) Relation Between B.M.& Spacing



Fig(8) Relation Between O.W. Of Pitched Roof For Slop 20% To O.W.Of Portal Frame & Span.

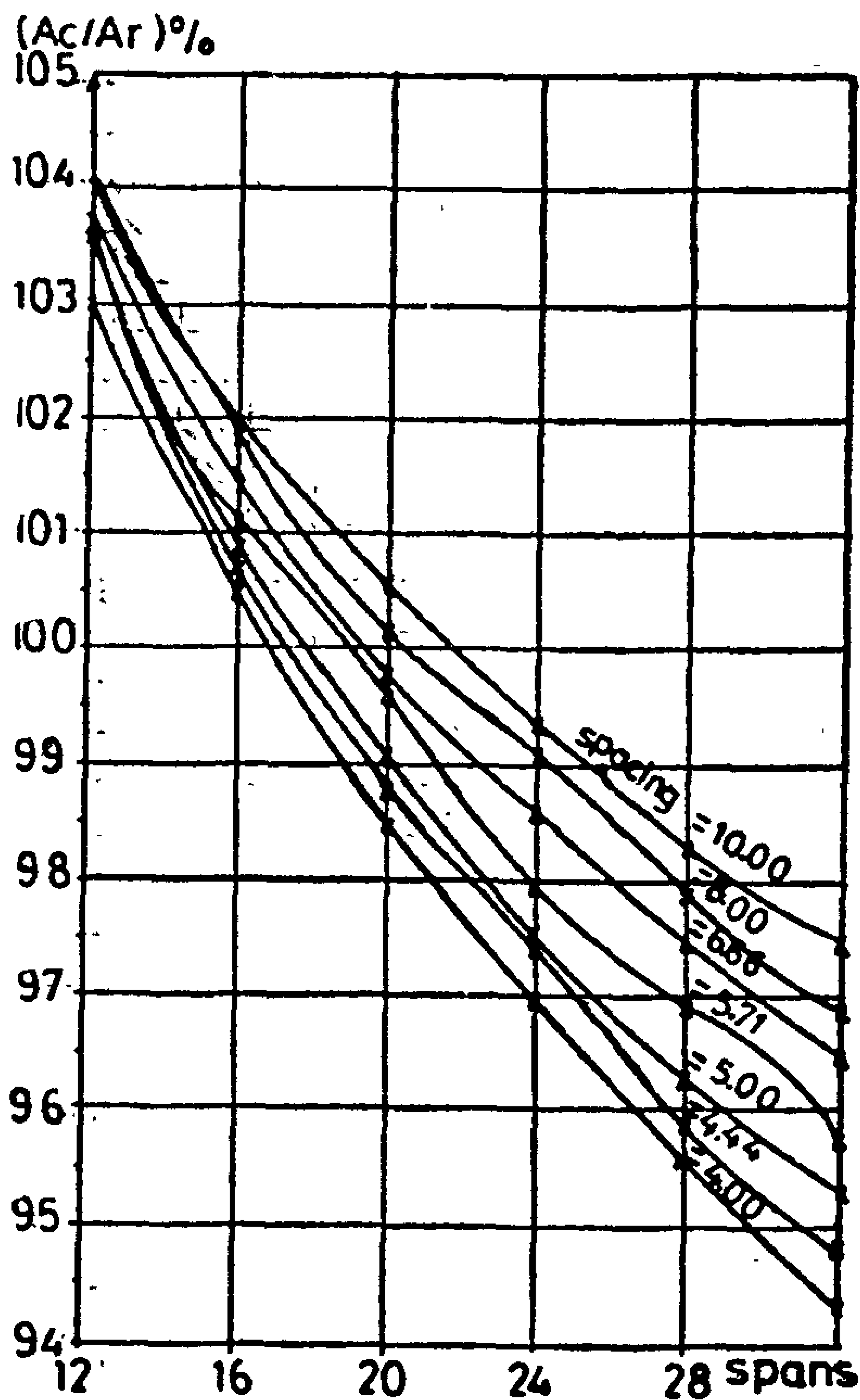
·6 — The comparison of the results obtained in this study with the results obtained for the pitched roof frames with slopes 20% and 50% under the same case of loading, spans and spacings is given in Figures 8 and 9. It can be easily seen that the ratio between the optimum own weight of steel pitched roof frame to steel portal frame decreases with the increase of both span and spacing. The ratio varied from 104% and 123% at small spans and spacing values, to 72% and 52% at bigger spans and spacings. Consequently, authere suggest that designres may use the portal steel frame for a hall with spans equal or less than 13 ms while the use of pitched roof frames is recommended for spans bigger than 13 ms or according to Figures 8 and 9.



Fig(9) Relation Between O.W.Of Pitched Roof For Slop 50% To O.W.Of Portal Frame & Span.

5— CONCLUSIONS

This paper describes the optimum elastic design of steel portal frames using



Fig(4)Relation Between (Ac/Ar) And Spans.

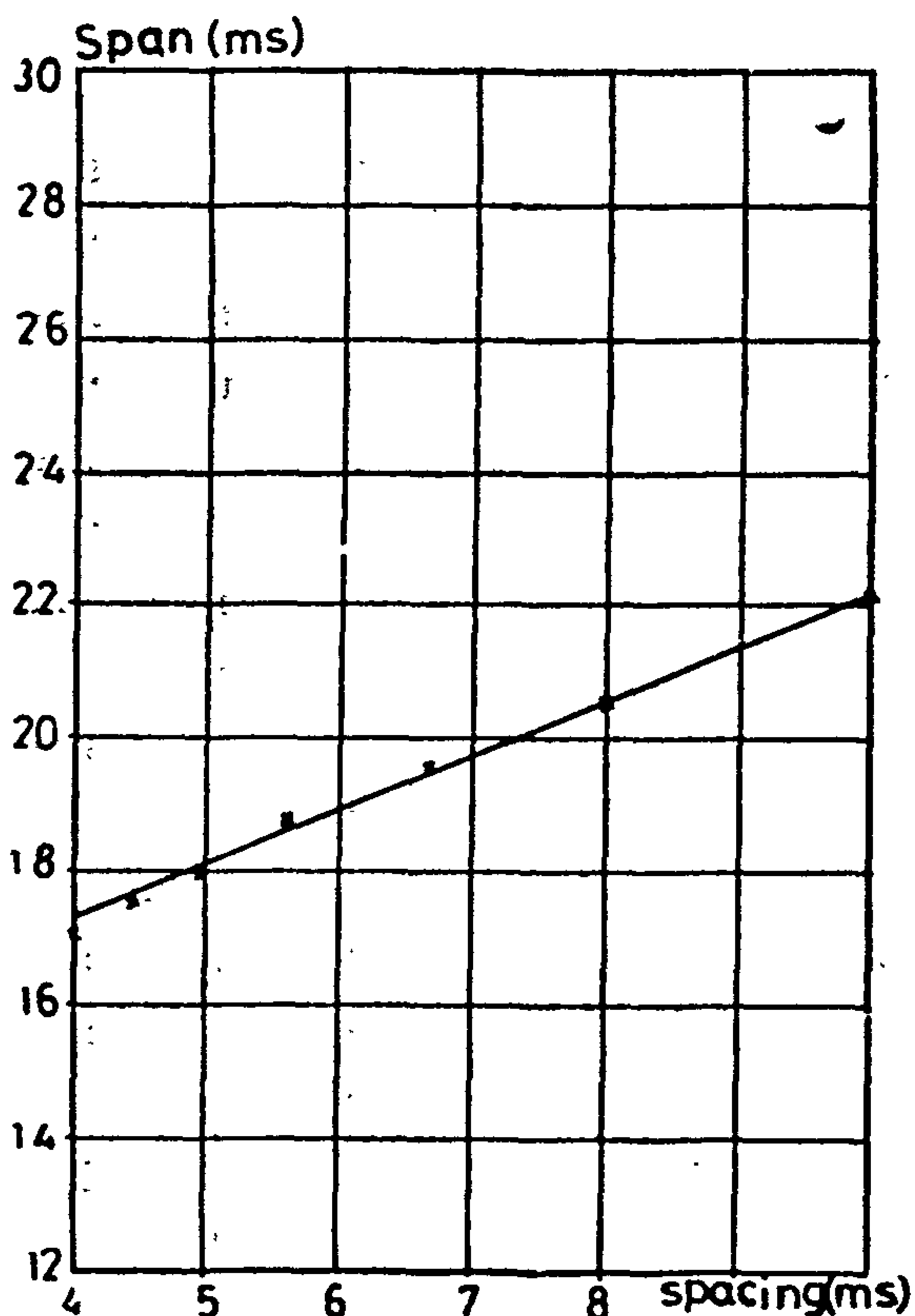
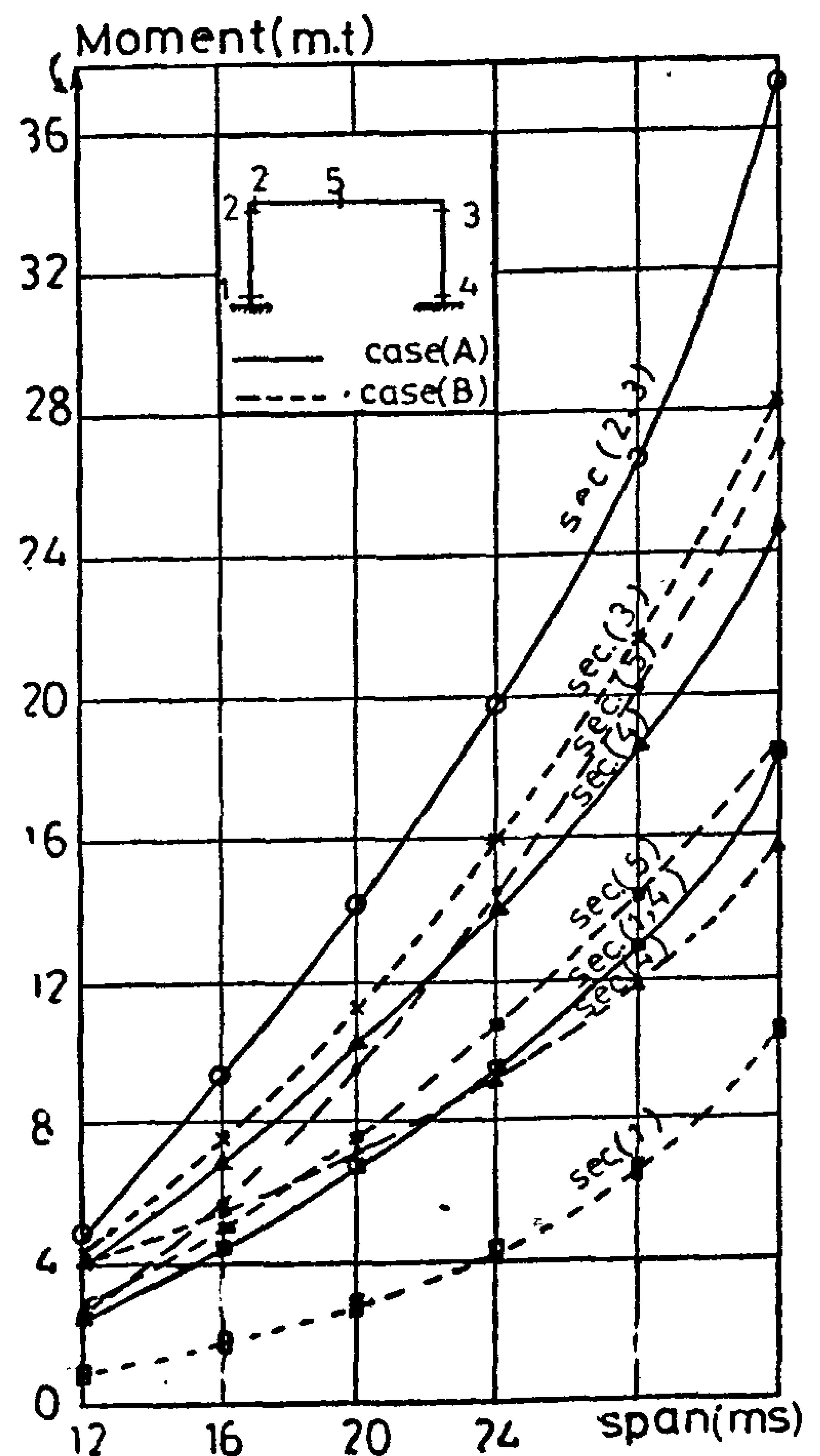


Fig.(5) Optimum Relation For Ac=Ar

4 — The variation of the value of bending moment at critical sections 1-1, 2-2, 3-3, 4-4, and 5-5 with span and spacing is shown in Figures 6 and respectively. It is clear that the case of dead and live loads (Case A) governs the design for both a column and rafter for all values of spans and spacing rather than case of dead, live and wind loads (Case B).



Fig(6) Relation Between B.M. & Spans

5 — Figures 2 and 3 indicate that as spacing and spans increase the optimum weight of a frame and the optimum cross sectional area of both column and rafter increases.

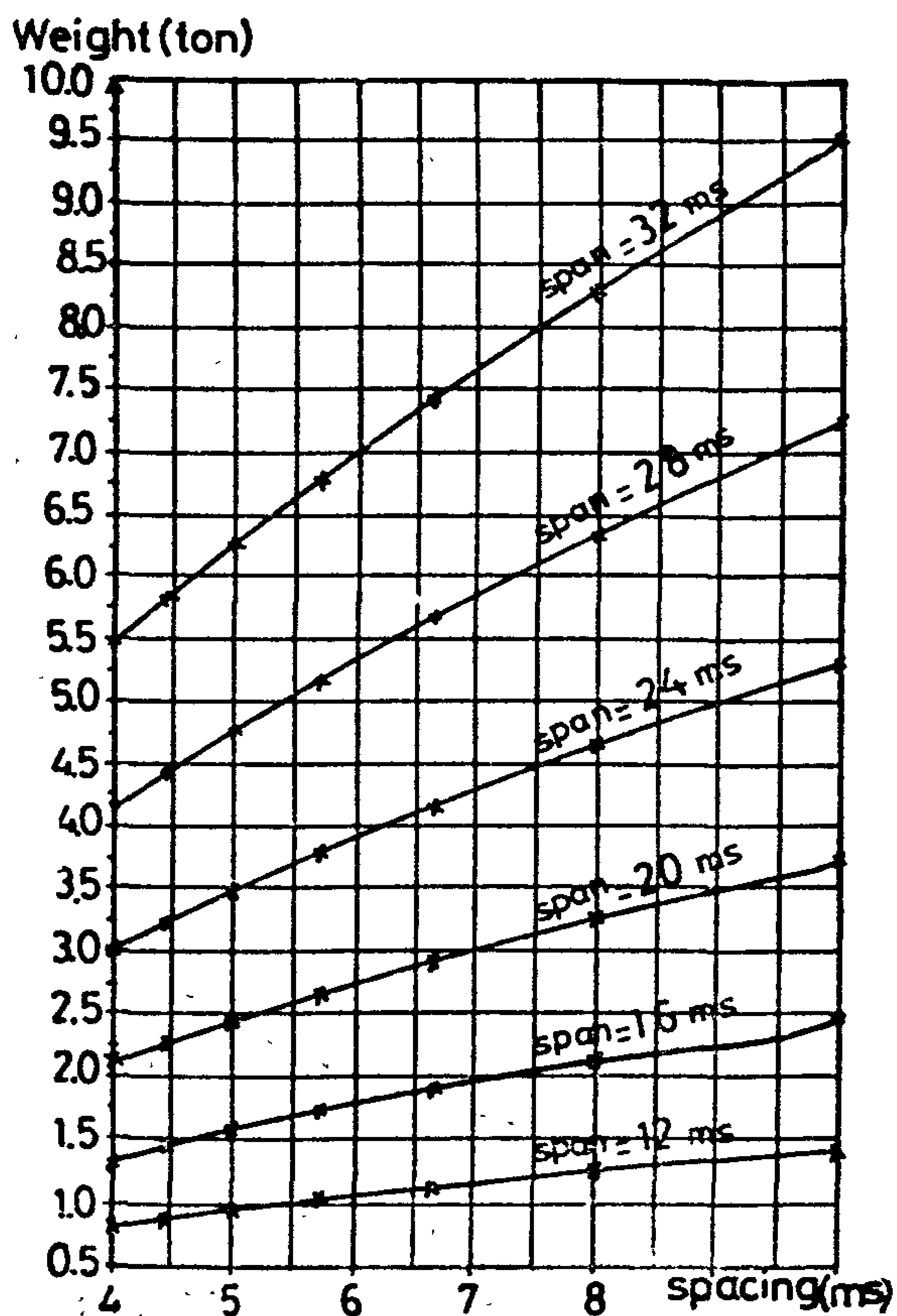
The frames are designed for both cases of loading;

Case A : Primary loads

Case B : Primary loads + Secondary loads.

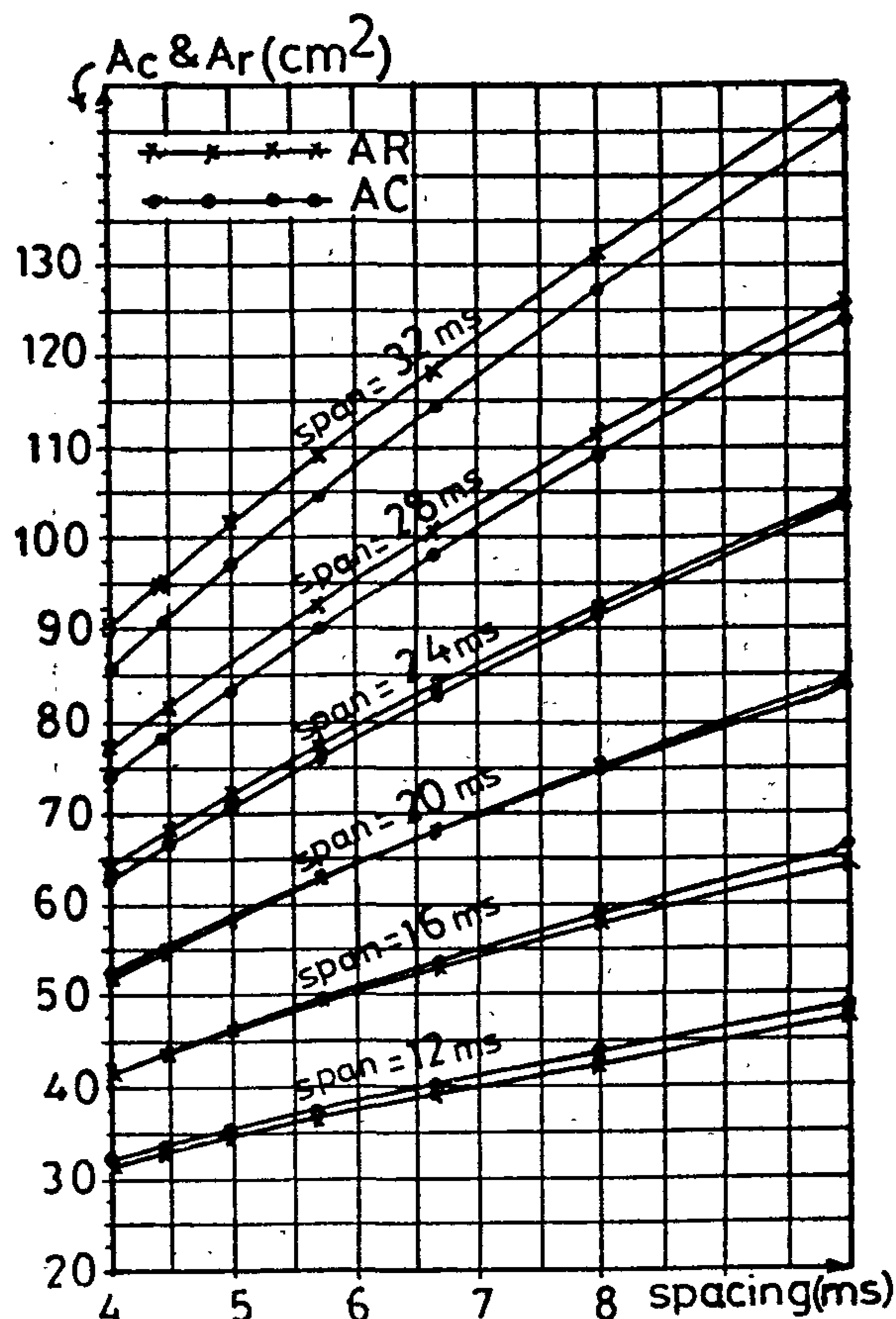
4 — ANALYSIS OF RESULTS

1 — Figure (2) shows the relationship between the spacing and the optimum weight of a frame for different spans. As the spacing and span increase the optimum required weight of a frame increases.



Fig(2)Relation Between Optimum Weight And Spacing

2 — Figure (3) shows the direct relation between the required optimum cross sectional area of column and rafter, and different spacing and spans.



Fig(3)Relation Between Optimum Area And Spacing

3 — Figure (4) shows that the relationship between the span and the cross sectional area of a column related to area of rafter (Ac/Ar). The optimum cross sectional area of rafter is less than the optimum cross sectional area of column for; spans less than 17 ms. With different values of spacing. Whereas for spans bigger than 22 ms. the optimum cross sectional area of a column is less than the optimum area of refter for all different values of spacing. On the other hand the optimum cross sectionol area of a column and rafter may be equal for spans bigger than 17 ms and less than 22.0 ms depending on the spacings and according to optimum relation given in Fig. (5).

The results of this study are given in form of design charts so that structural designers can use them easily.

2 — STRUCTURAL OPTIMIZATION

The iterative method used to determine the optimum elastic design of a structural based on stress and deflection constraints. The design constraints is formulated by using the first order Taylor expansion of functions.

The analysis of the structure is carried out using the displacement method and the elimination technique for the solution of the symmetric banded stiffness matrix (13). The iterative method assumes an initial lower bound for the design variable which is going to be modified to satisfy the various requirements. The simplest design variable is the moment of inertia of flexural member. The relation between the cross-section area and other section properties has been obtained (8) for the IPE sections. —

The first order Taylor expansions for a function F of a design variables from an initial value Fo to a certain value is

$$F = F_o + \Delta F \quad \cdots\cdots\cdots\cdots\cdots [1]$$

Or

$$F(A_o + A) = F(A_o) + \sum_{j=1}^{m} \frac{\partial F(A_o)}{\partial A_j} \cdot \Delta A_j \cdots [2]$$

m is the total number of variables.

In the optimum structural design problem, Equ. 2 is used to determine the best changes in the cross-sectional area of the member Δ A that should be made in order that the design constraint F(Ao) may not exceed its permissible value F (Ao + Δ A). The deflection and stress constraint can be expressed using equation 2. In flexural member the permissible stress is a function of the design variables and a modification to the stress constraint must be made.

The simplex method (11) is used to solve the deflextion and stress constraint equations, where the initial design assumed to be a lower bound design. A computer program associated with the iterative method has been used to analysis of the frame with initial values of the different constraints. If the design constraints are satisfied, the optimum solution is obtained. Otherwise, each design variable is updated by a small factor while the other variable are kept constant at the initial design values and further analysis is made.

To reduce the number of iterations required, the starting point - lower bound design - has to be closer to the optimum design. By investigating the results, the the starting point may be modified to increase the convergence.

3—FRAME GEOMETRY AND DESIGN

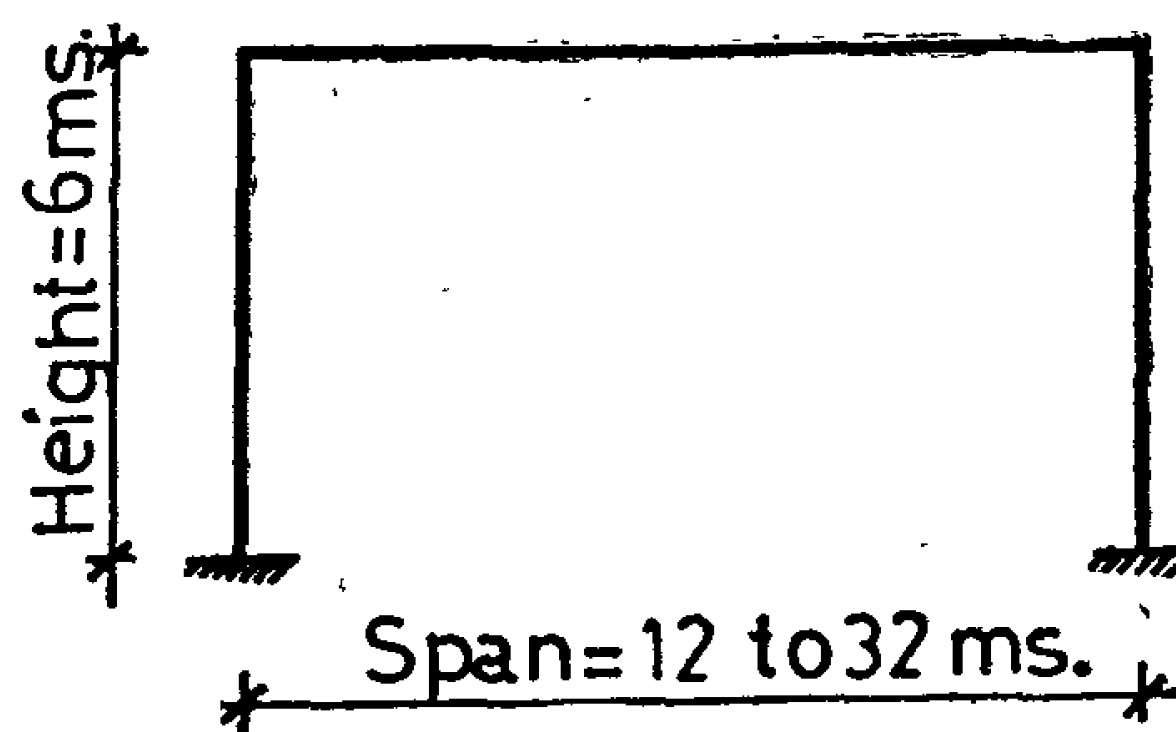


Fig. (1) Dimensions of portal frame

The dimensions of portal frame are given in Figure (1). The span is chosen from 12 ms to 32 ms in a 4.0 ms step and the clear height is constant and equals 6.0 ms. the spacing between frame is chosen from 4 ms to 10 ms. The covering material is assumed corrugated steel sheets on steel purlins spaced 2.0 m apart. The material of frame construction is steel 37 with modulus of elasticity of 2100 t/cm2. The sections for the frame members as are assumed to be I.P.E. sections (12). The design is carried out according to ESS.

OPTIMUM DESIGN OF PORTAL FRAMES

Dr. S. Abdel Salam (1) Dr. N. Mahmoud (2) Eng. H. Mohamed (3)

ABSTARCT

This paper investigates the optimum elastic design of portal steel plane frames covering a rectangular hall. The design problem is how to determine the best cross-sectional areas of the different members in the structure so that the volume of structural steel is kept to minimum. The stress and deflection limitations follows the ESS recommendations

An Iterative method which uses Taylor's first order series expansion to express the various required constraints is used. The linear programming is used to solve the problem.

Design charts were obtained in this study for a wide range of spans and spacing between frames. These charts are recommended to be used by structural designers. The optimum relation which give equal areas of column and rafter is presented. A comparison study between the current results and the results obtained for the pitched roof frames is introduced.

I — INTRODUCTION

Structural optimization depends on the accuracy taken in the structural analysis itself which in turn requires the dimensions of cross sectional area of various structure members. Usually the cross sectional areas are assumed in the first stage of the analysis. The method for the structural optimization has been done by transforming the structural design problem into a solvable mathematical optimization one, in order to determine the optimum cross-sectional area of the different structure members.

In the past two decades, the problem of structural optimization was treated by many researchers using non-linear programing (1), (2), (3), (4), (5) and (6). On the other hand and because of the complexity of non-linear programing, other researchers used the linear programing for solving the problem (7), (8), (9), (10), (11) and (12). The results of linear programing were very close to the results obtained using non-linear programing, the maximum variation using the iterative method, was within two percent (1).

The present study deals with the problem of the optimum elastic design of fixed portal steel frames using linear programing. An Iterative method which uses Taylor's first order series expansion to express the various required constraints is used.

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5 — The increase of the neighbour load distance (X) from the existing building decreases the corresponding induced moments - in the existing building foundation. In all the cases studied, the induced moments for a load distance of 6.0m are nearly half those for a load distance of 1.0m. For load distance more than 6.0m, the effect of increasing the load distance is less pronounced.

Storey Number	1,2	3,4	5,6	7,8	9,10	11,12
External Columns	30X100	30X90	30X85	25X85	25X75	25X60
Internal Columns	40X140	40X130	35X125	35X110	30X110	30X95

Table (1) Columns cross-section (cm)

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1 = 0.8 m
Es = 500 t/m2
N = 12 STOREYS.

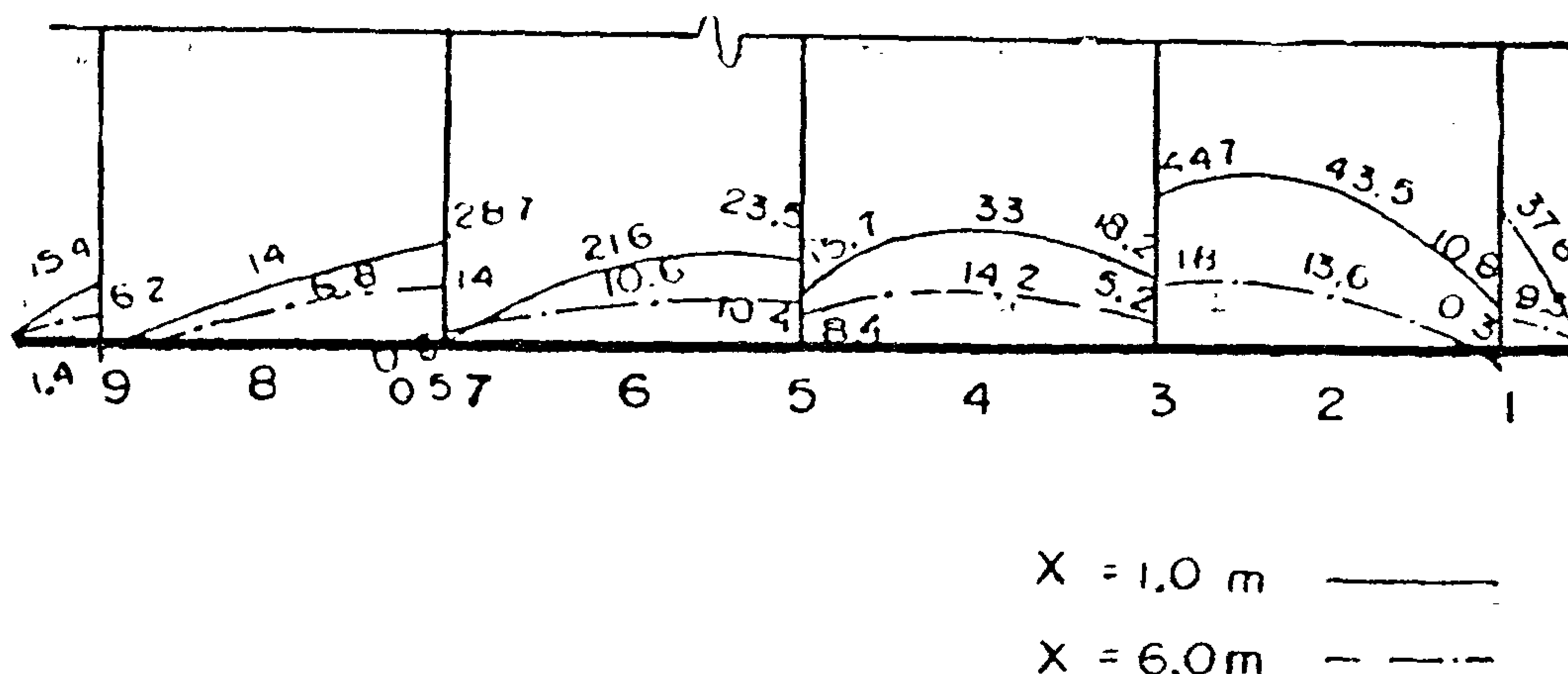
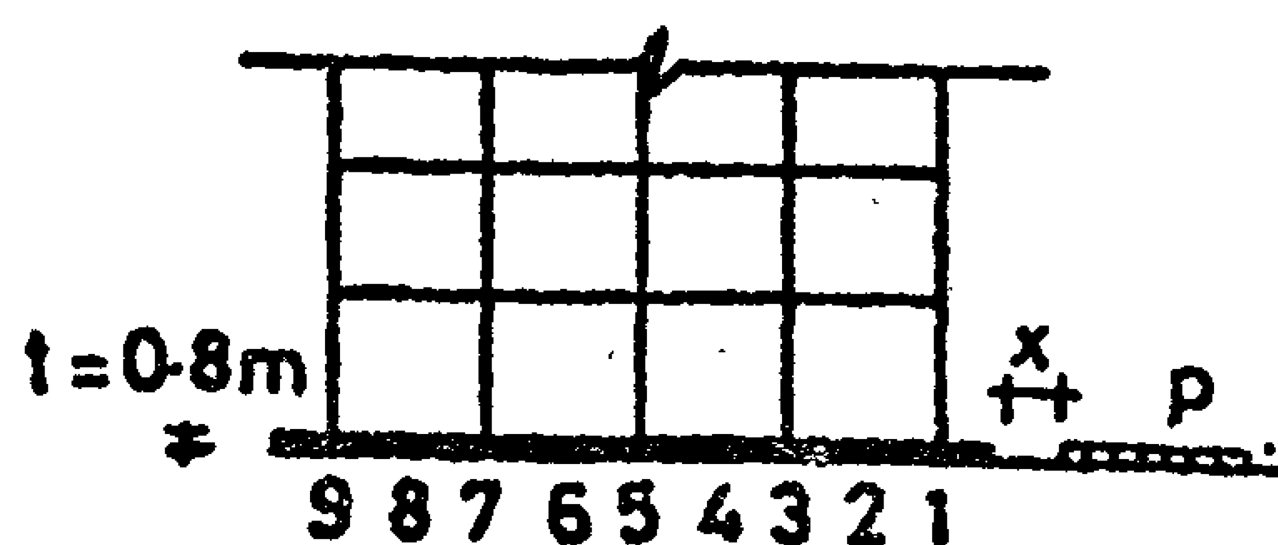


Fig. (10) Variation of internal moments induced in the raft foundation for different load distance (X).

(Mf max = 44 .7m.t)
t = 0.8 m
E_s = 500 t/m^2
N = 12 STOREYS
R = RIGHT SEC
L = LEFT SEC



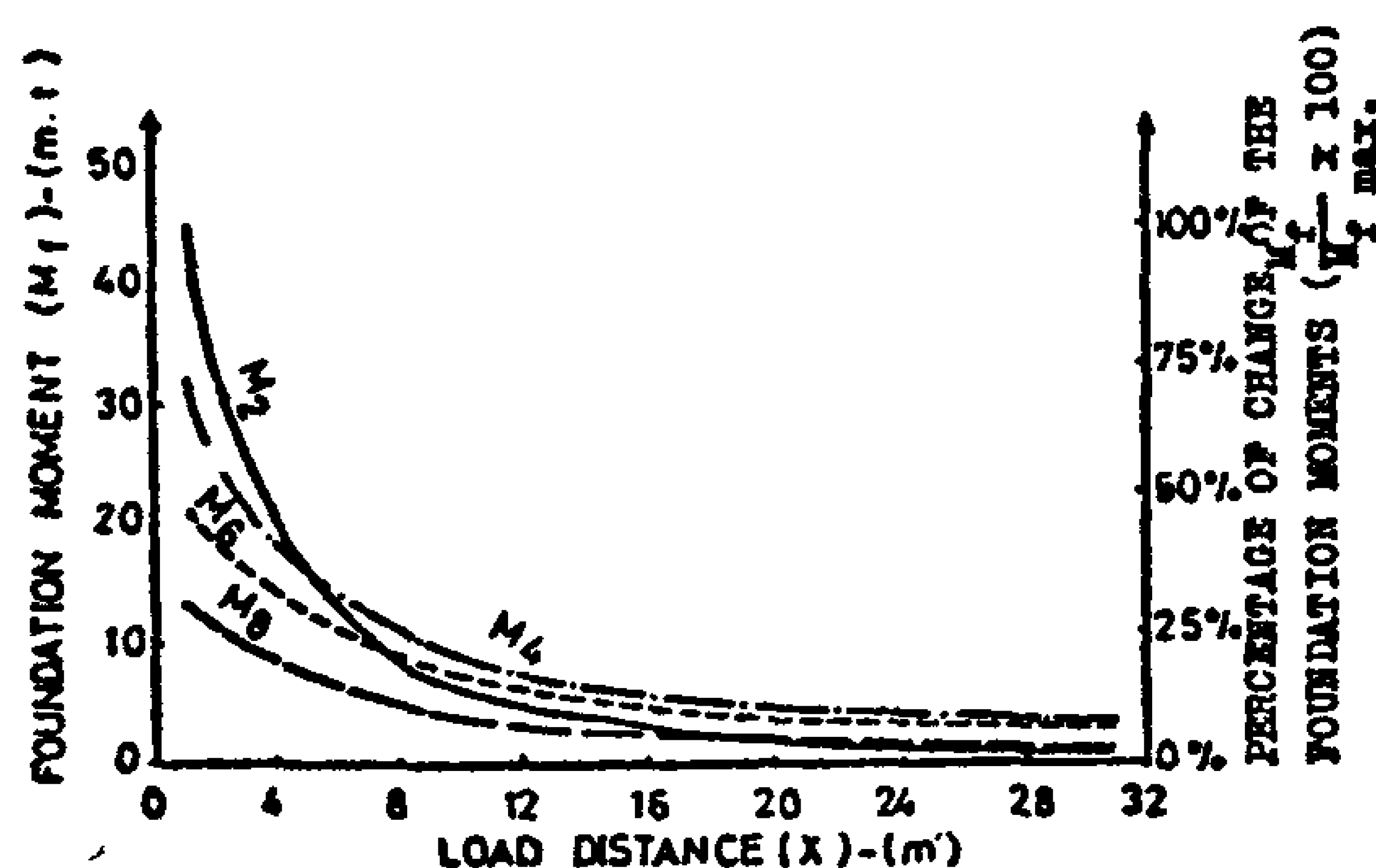


Fig. (11) Egect of the load distance (x) on the internal moments induced in the raft foundation at section 2,4,6 and 8.

CONCLUSION

1 — The model proposed in this work provides a relaiable tool for pridicting the structural behaviour of the raft foundation taking into account the properties of both the building frame and the supporting soil.

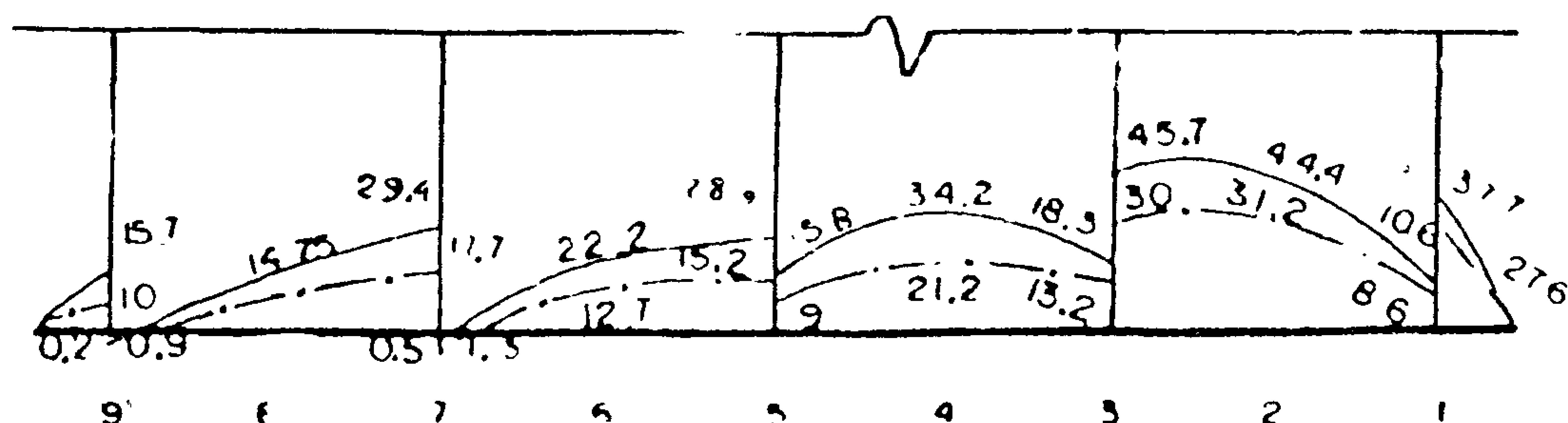
2 — Using the developed interface friction element, the inrernal forces and stresses are determined allowing for the eflect of the interface strength which was ignored by previous investigators.

3 — The presence of the neighbour load causes a sagging bending moments in the foundation. The values of the moments are higher in the sections of the foundation near the neighbour load than those at the sections far from it.

The values of moments at different sections of the foundation increase with the increase of the foundation thickness.

4 — The bending moments in the raft foundation, caused by the neighbour load, decrease with increasing the soil stiffness,

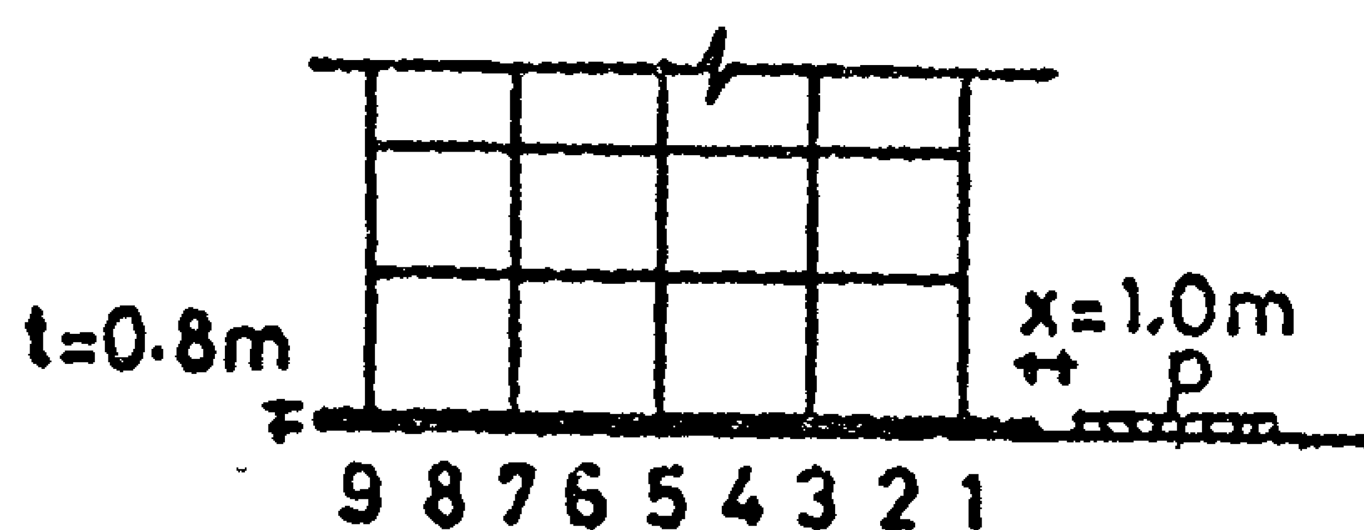
t = 0.8 m
N = 12 Storeys
X = 1.0 m



$E_s = 200\ t/m^2$ ———
$E_s = 5000\ t/m^2$ — — —

Fig. (8) Variation of internal momentsin the raft foundation for different soil modulus of elasticity (Es).

($M_{f\,max}$ = 81.2 m.t)
E_s = 500 t/m^2
N = 12 STOREYS
X = 1.0 m
R = RIGHT SEC
L = LEFT SEC



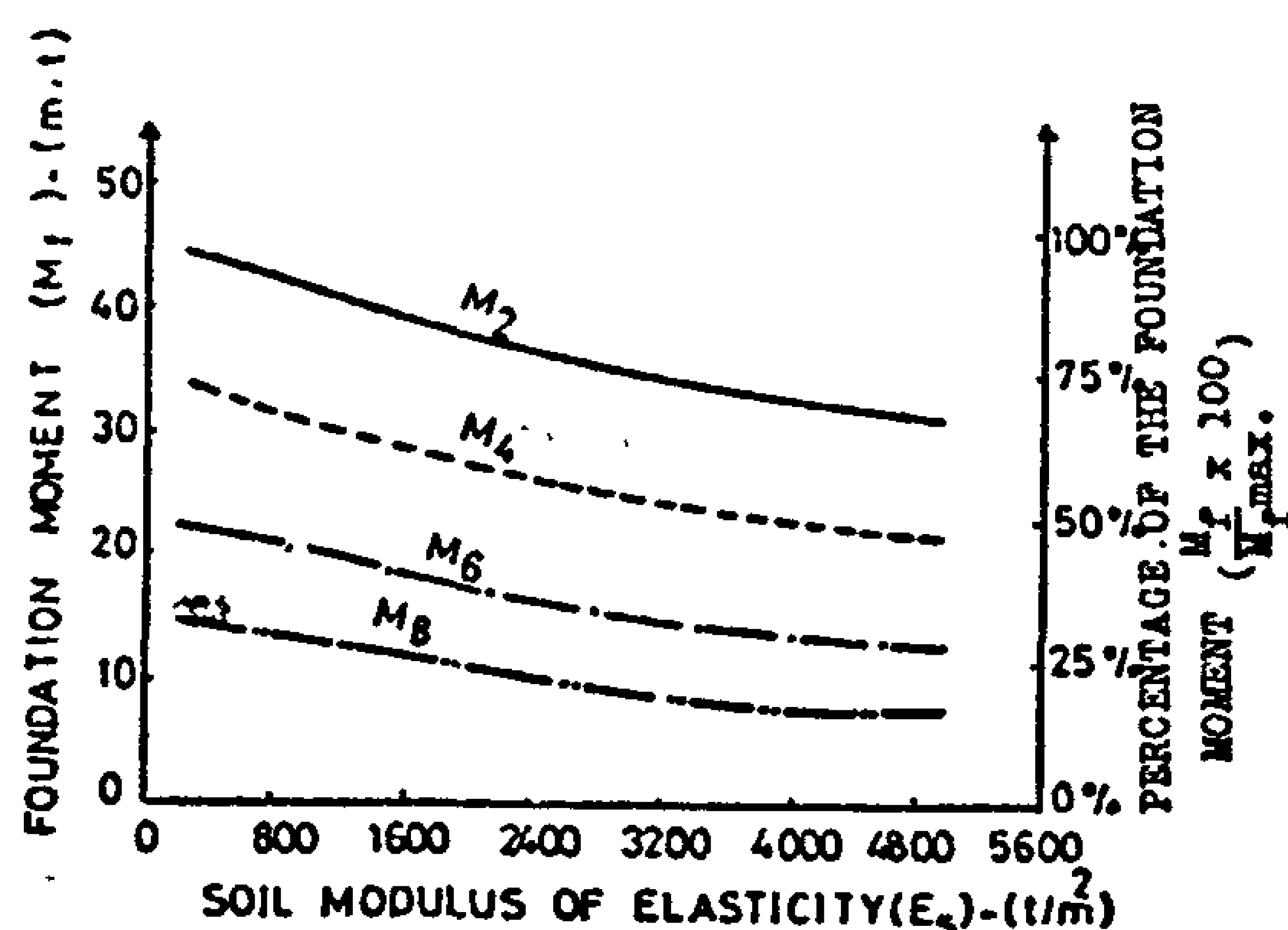


Fig. (9) Effect of the soil modulus of elasticity (Es) on the internal moments induced in the raft foundation at section 2,4,6 and 8

EFFECT OF THE NEIGHBOUR LOAD DISTANCE (X)

The distance (X) from the neighbour load edge to the edge of the existing building foundation was assumed to vary from 1.0m to the raft foundation. For all the case considered the soil modulus of elasticity was taken constant and equal to 500 t/m2.

—Figure (10) shows ahe raft foundation moments due to the presence of the neighbour load at 1.0 meter and 6.0 meter from the edge of the existing building foundation. Figure (11) shows the variation of the moments at the different sections of the foundation.

Figure (10) shows the raft foundation moments due to the presence of the neighbour load at 1.0 meter and 6.0 meter from the edge of the existing building foundation. Figure (11) shows the variation of the moments at the different section of the foundation with the variation of the neighbour load distance. It can be seen that the foundation moments decrease with the increase of the distance (X). It was also found that for load distance greater then 6.0m the moments induced in the raft are that small.

Es = 500 t/m2
N = 12 STOREYS
X = 1.0 m

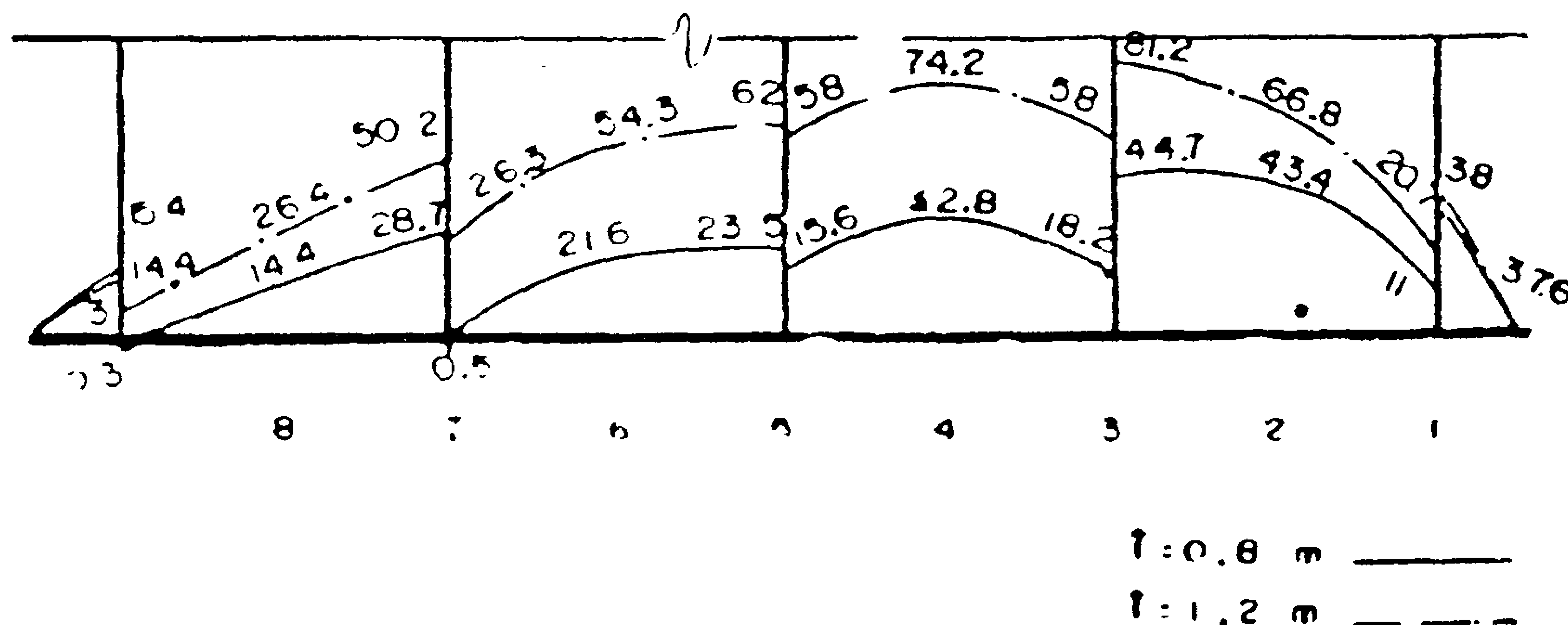


Fig. (6) Variation of internal moments in the raft foundation for different foundation thickness (t).

(M_f max= 45.7m-t)
t =0.8 m
N=12 STOREYS
X=1.0 m
R= RIGHT SEC
L=LEFT SEC

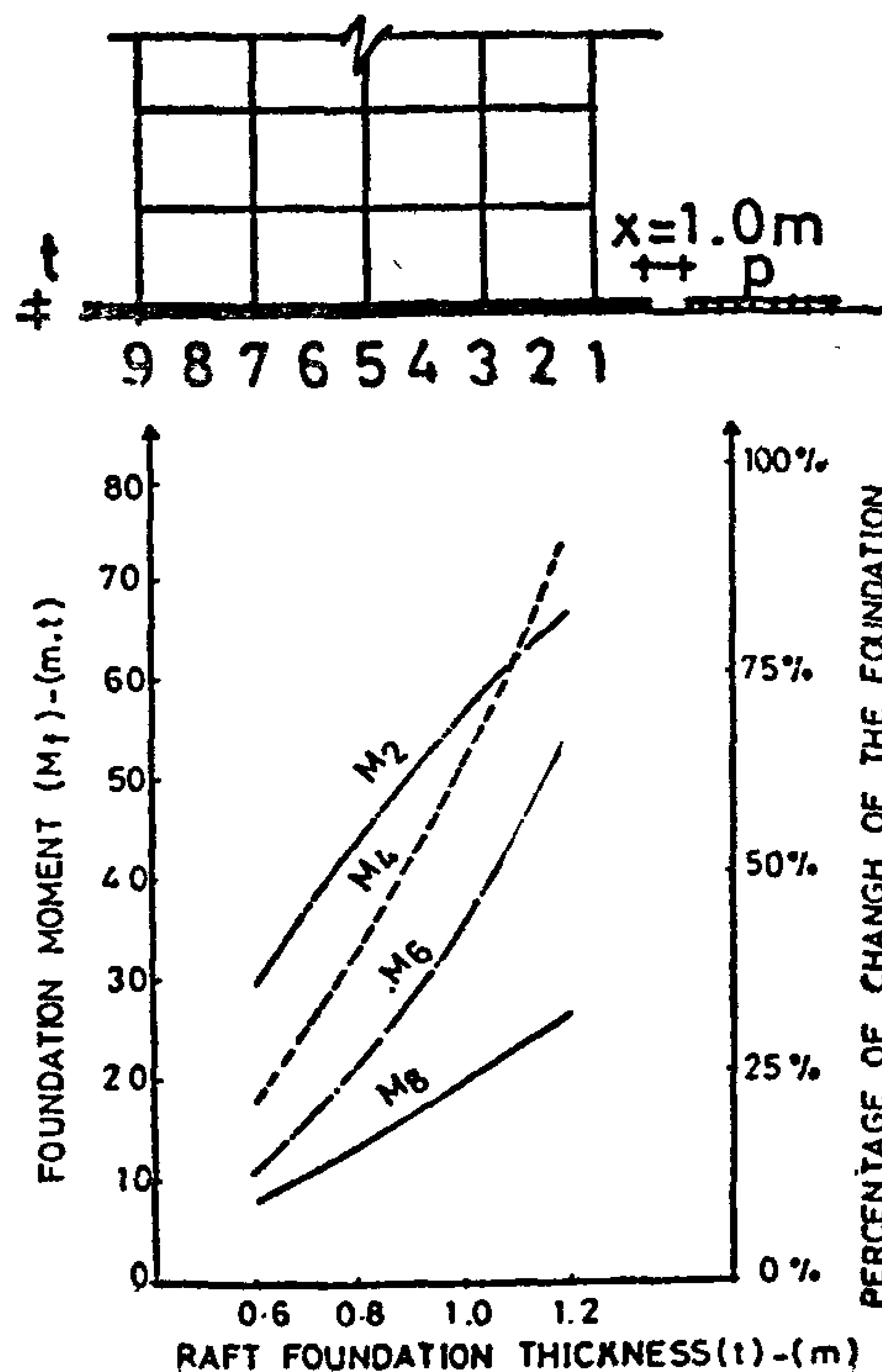


Fig. (7) Effect of the raft foundation thickness (t) on the internal moments induced in the raft foundations at sections 2,4, 6 and 8.

EFFECT OF THE SOIL STIFFNESS

Different values of the soil modulus of elasticity (Es) were considered in the analysis to study the effect of the soil stiffness. The soil modulus of elasticity was assumed to vary from 200 t/m2 for weak soil to 5000 t/m2 for stiff soil [4]. for all cases studied the neighbour load was kept at a distance (x) equal to 1.0 m.

Figure (8) shows the bending moments induced in the raft foundation due to the presence of the neighbour load for the two cases considered i.e. for both weak soil having modulus of elasticity of 200 t/m2 and for stiff soil having modulus of elasticity 5000 t/m2. This figure shows that the moments are higher in the case of weak soil.

Figure (9) presents the variation of the moments at different sections of foundation for soil different modulus of elasticity. The figure indicates that the values of the bending moments decreases rapidly with the increase of the soil modulus of elasticity from weak soil to soil with medium rigidity and then the rate of decrease is somewhat less steep for stiffer types of soil.

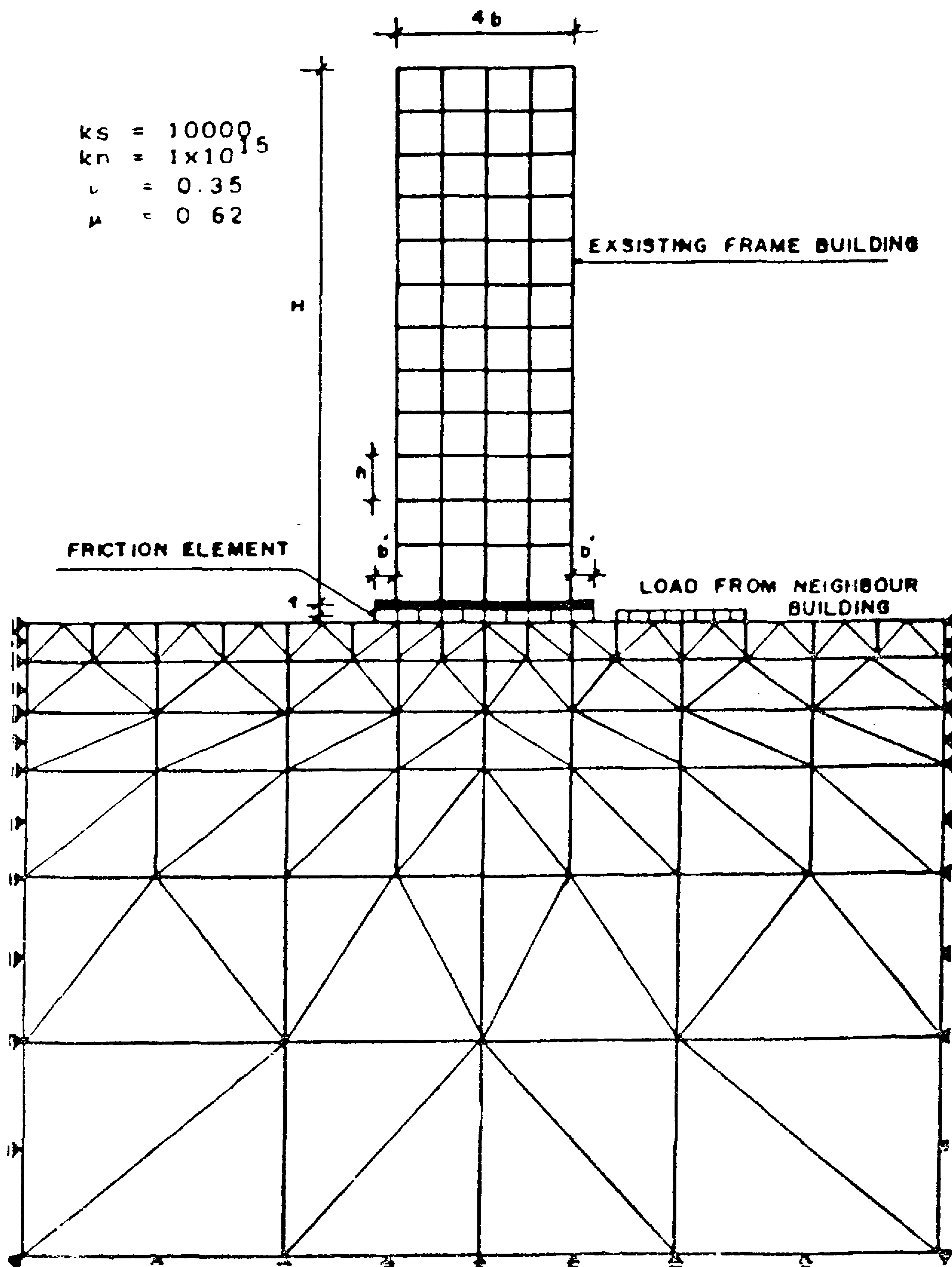


Fig. (5) Typical finite element mesh.

Figure 6 shows the variation of the moments in the foundation thicknesses of 0.8m and 1.2m due to the presence of the neighbour load at a distance of 1.0 m from the edge of the building foundation. The figure shows that the presence of the neighbour load causes a sagging bending moments in the foundation. Increasing the raft foundation thickness increases the value of the foundation moments The moments are higher in the sections of the foundation near the neighbour load than those at the sections far from it.

Figure (7) shows the bending moments at different sections of the raft for different foundation rigidity represented by its thickness. The figure indicates that the values of these moments increase rapidly with the increase of the foundation rigidity.

where,

σn and σs are the normal and tangential stresses and Δn and Δs are the relative normal and shear displacement.

This finite element idealization has a considerable flexibility in assigning the effect of the different material properties for both soil and super-structure, therefore different practical cases can be studied.

CASE - STUDY

The analysis of a twelve storey four bay building (Fig. 4) was carried out in this study. The distance between each two successive frames is assumed equal to 4.0m which is taken as the breadith of the cross-section at the foundation.

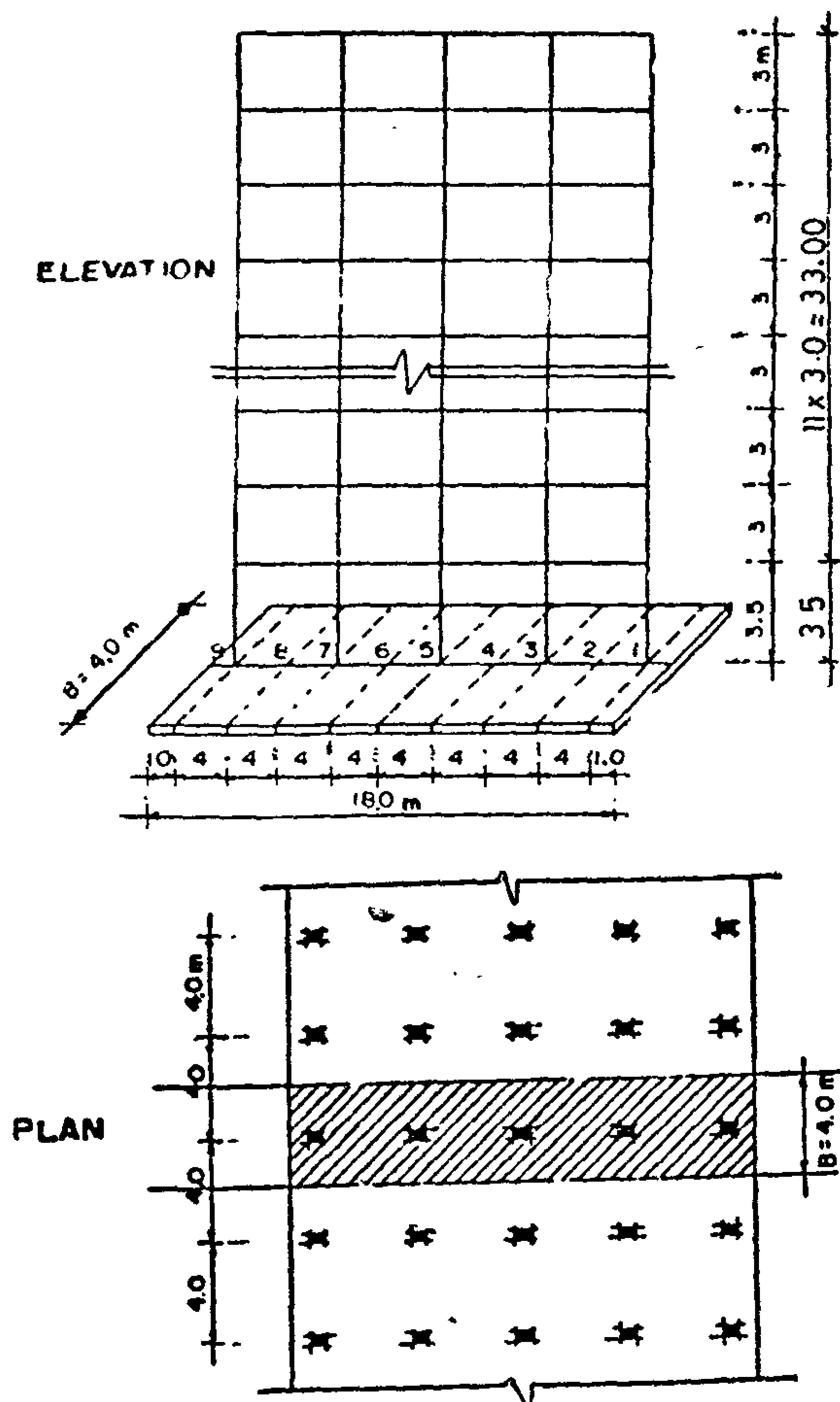


Fig. (4) Configuration of the structural model.

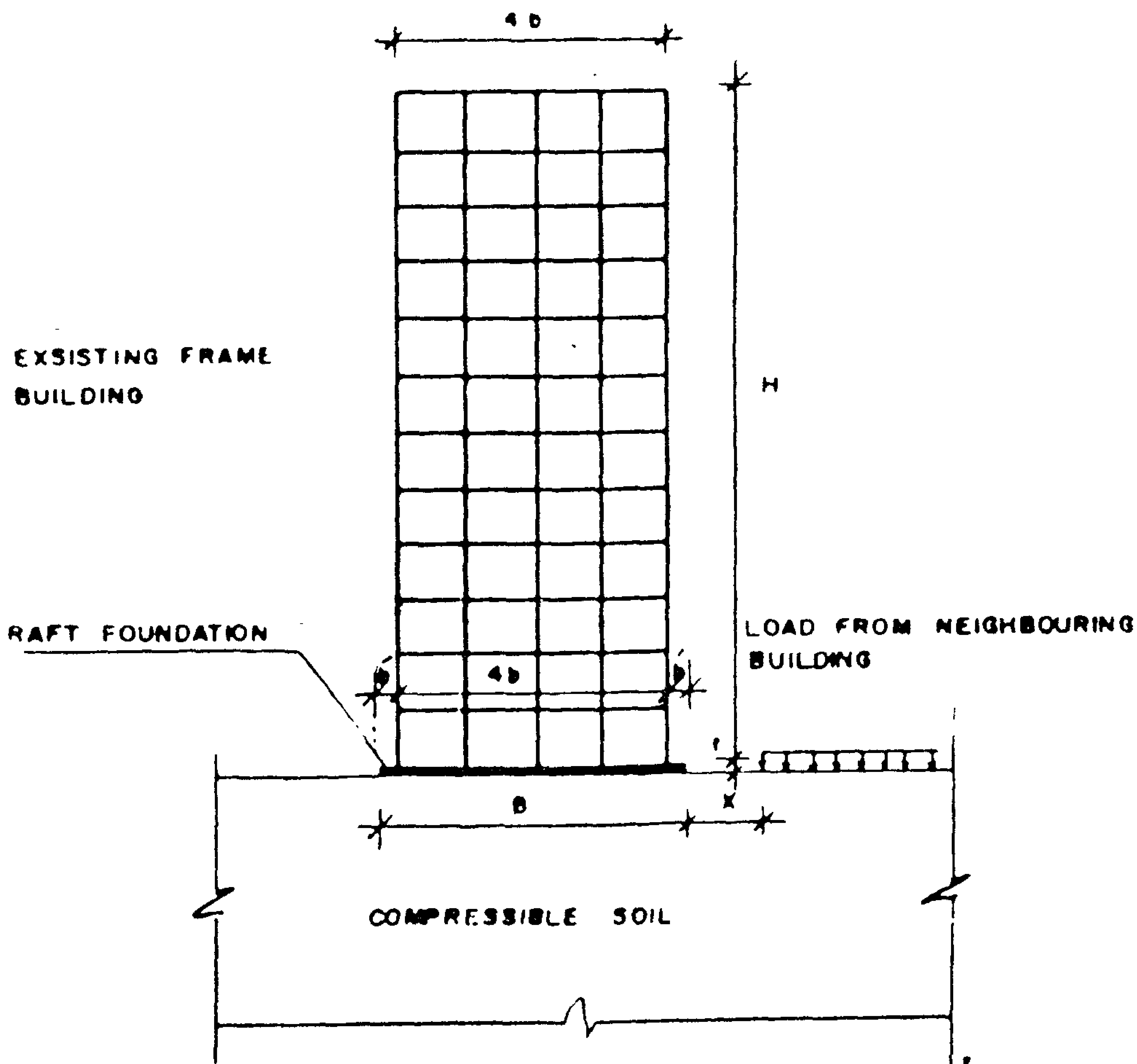
A cantilever part of 1.0 m is assumed at each side of the foundation. The distance center line to center line of the columns is eqoal to 4.0 ms. The columns height is assumed equal to 3.5 ms for the first floor and 3.0 ms for all other floors. Practical dimensions are chosen for the cross-sections of the different elements of the frame super-structure. The breadth of all the beams is equal to 0.12m and the depth of all the beams is equal to 0.7m. The cross section for all the columns is taken as shown in table 1.

All the frame buildings were investigated under the action of a neighbour uniformly distributed load equal to 40 t/m representing a neighbour building of about 8 storeys rested on a raft foundation of 20 ms breadth. The soil poisson's ratio (v) was given a value of 0.35. The coefficient of friction (u) was taken equal to 0.62 [3].

In this study the frame building was investigated under the action of the neighbour load which considered as an additional load to the applied loads acting on the existing frame building. Therefore, the possibility that a separation between the raft foundation and the supporting soil would take place, is respectively small. Accordingly, in this study it is assumed that no separation will occur at the interface between the raft and the soil beneath. Thus, the unit normal stiffness (Kn) was given a relatively high value of 1x10-15 t/m3 On the other hand a value of 10000 t/m 3 was chosen for the tangential stiffness (Ks) based on previous findings [4,5]. Figure 5 shows the finite element mesh used in this study.

EFFECT OF RAFT FOUNDATION THICKNESS

To study the effect of the raft foundation rigidity the analysis was carried out with foundation thicknesses equal to 0.6, 0.8, 1.0, and 1.2ms. The soil modulus of elasticity was taken equal to 500 t/m2.



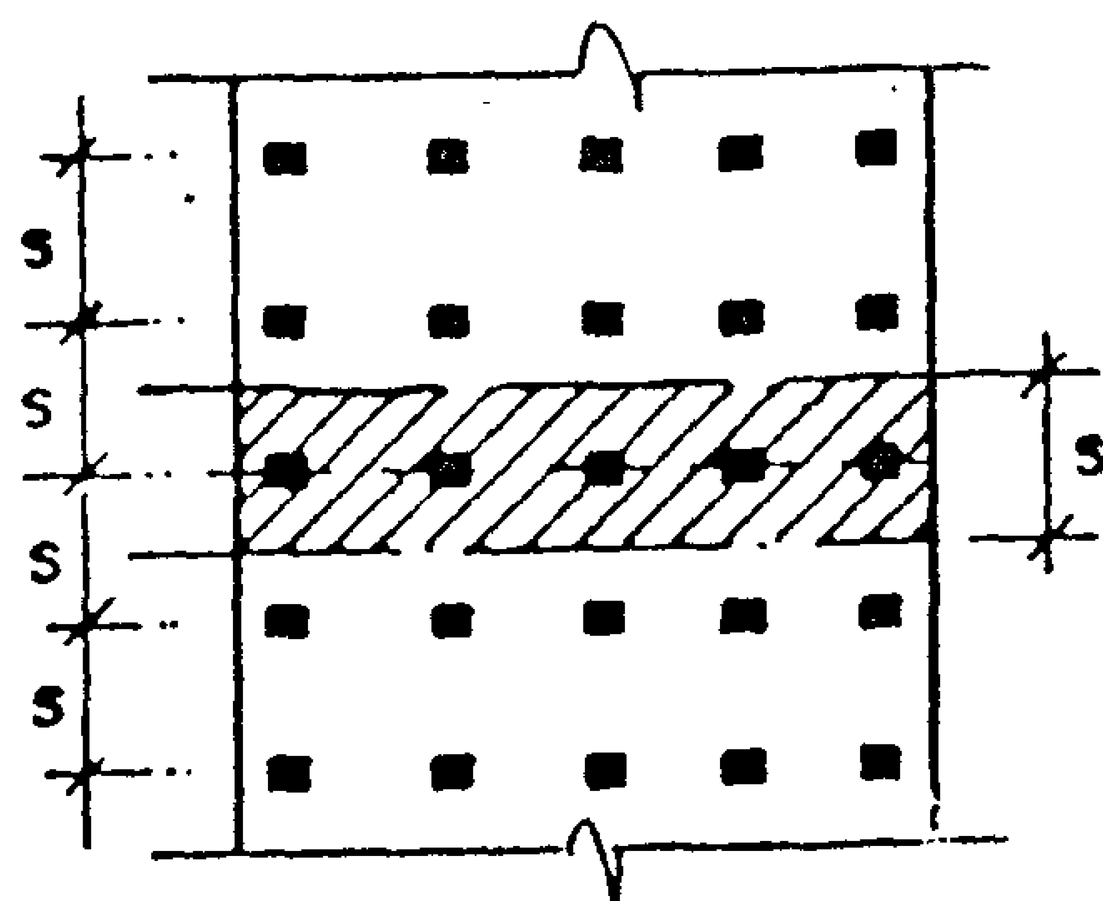


Fig. (1) : The finite element Model

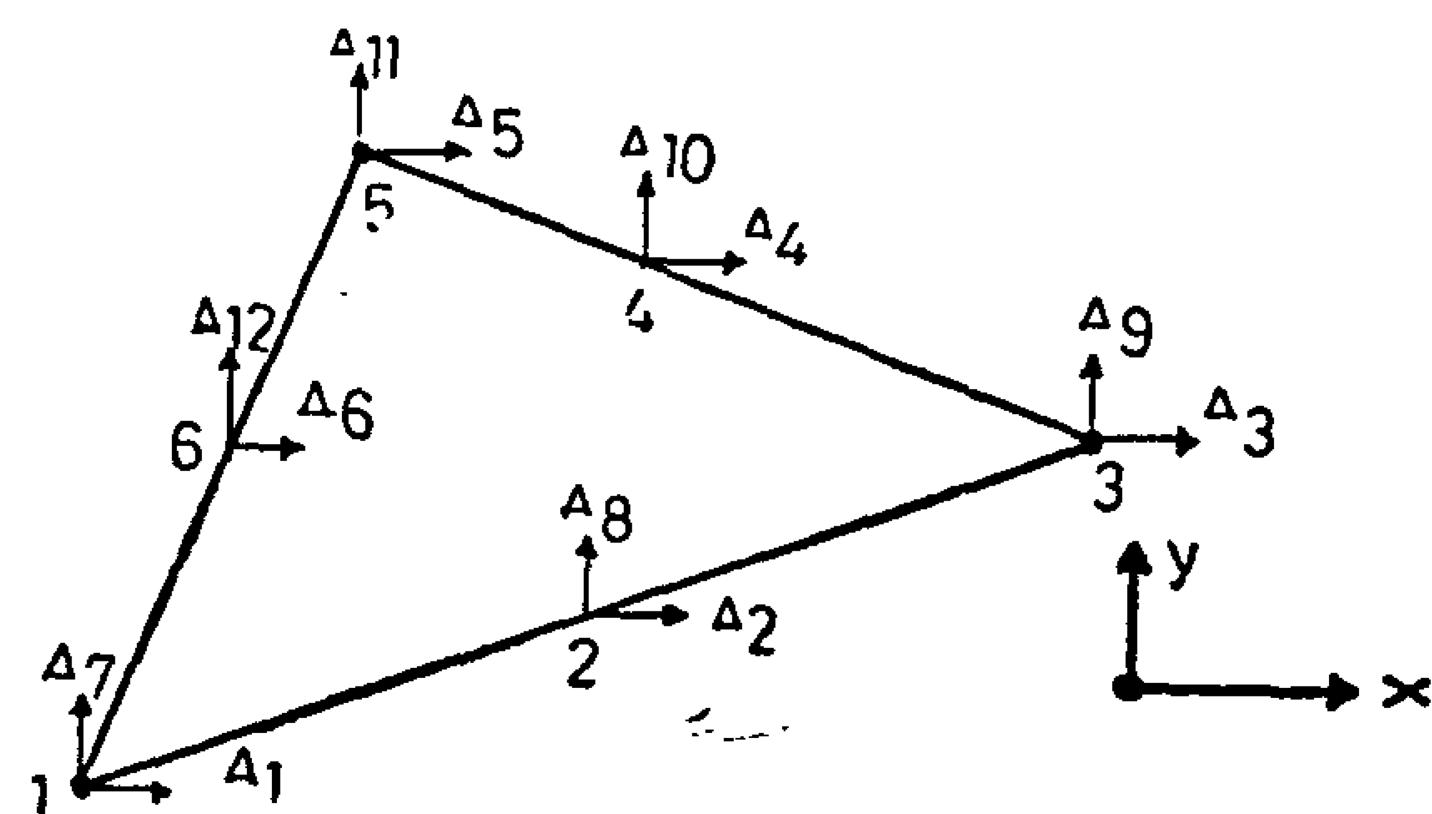


Fig. (2) : Linear strain trainglar finite element

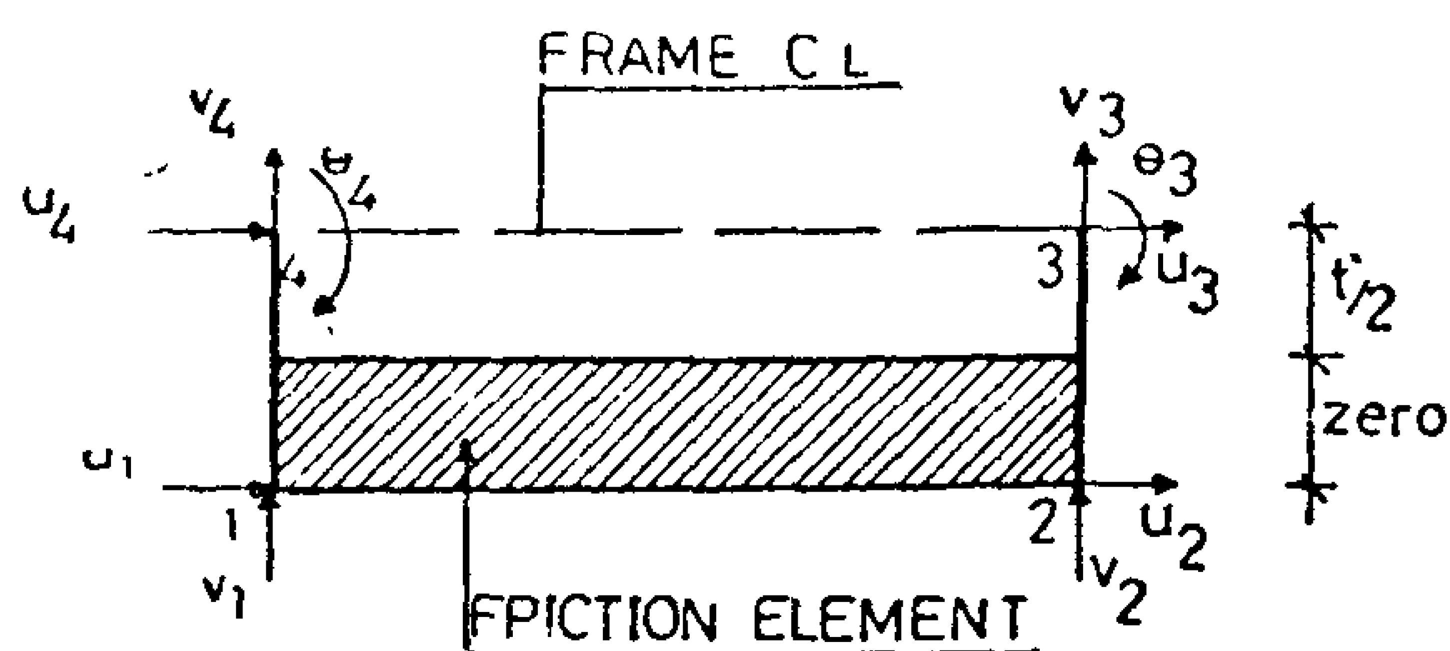


Fig. (3) : Modified friction Element

ween the frame element and two dimension finite elements was first introduced by Pandy [3] to idealize the interface between the frame element and two dimension finite element. This idealization allows for gap formation or slip at the interface. The stiffness of the friction element depends on the interface properties Kn and Ks, which can be defined by,

$$\sigma n = Kn \Delta n \quad (1)$$

and

$$\sigma s = Ks \Delta s \quad (2)$$

MONENTS INDUCED IN A RAFT FOUNDATION OF A MULTISTOREY BUILDING DUE TO THE CONSTRUCTION OF A NEIGHBOURING BUILDING

Eng. H.M. El-Sawah*, Dr. M. El-Kafrawy**, Prof. Dr. M. El-Adawy Nassef***

INTRODUCTION

Soil-Structure interaction problems draw the attension of many engineers and research workers because of their practical importance. An overall soil-structure interaction analysis, including the superstructure, its foundation and the supporting soil is a very complicated problem. However, the finite element method can be used to solve the problem in one integrated model. The finite element method has also considerable flexibility in assigning and modifying the different properties for both soil and superstruuture, therefore different practical cases can be studied using just one model.

This study has been carried out to investigate the parameters affecting the relation between the neighbour load simulating the new building and the bending monents induced in the raft foundation of an existing building. These parameters are the reft foundation thickness, soil stiffness and the distance between the two buildings.

FINITE ELEMENT MODEL

The finite element model used in this study is to simulate four bay multi-storey building frame resting on a raft foundation of a given thickness on a clay soil media (Fig. 1). The finite element analysis is based on the following assumptions[1]:

1 — The materials of both the structures and the supporting soil are linear, elastic, homogeneous and isotropic.

2 — The building is assumed to be very long in the transverse direction, therefore, only one typical panel has been considered in the analysis.

3 — Uniform load of intensity q at a given distance from the existing building foundation is introduced to simulate the effect of the new building.

4 — The foundation is assumed to be equally subdivided by nodal lines determining the nodal points of the foundation The breadth of foundation is taken equal to the distance center line to center line of two successive bays.

5 — Torsional effect is neglected

In the finite element analysis the soil is represented by linear strain triangular elements (Fig. 2), while regular frame elements are used in representing the building frame and its raft [2] .

The interface betwen the raft foundation and the subgrade soil is represented by the friction elements shown in (Fig.3). This element was first introduced by Pandy [3] to idealize the interface bet-

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Table 1

The degradation depth for Aswan-Esna) reach after 1964 in cm.

Time in years / Distance in km.	10	20	30	40	50
10+	3.99	4.78	4.94	4.96	4.97
20	7.97	9.56	9.87	9.94	9.95
30	11.96	14.34	14.81	14.90	14.92
40	15.94	19.12	19.75	19.87	19.90
50	19.93	23.89	24.69	24.84	24.87
60	23.91	28.68	29.62	29.81	29.85
70	27.89	33.46	34.56	34.78	34.82
80	31.88	38.24	39.49	39.74	39.79
90	35.87	43.01	44.43	44.71	44.77
97++	38.66	46.36	47.89	48.19	48.25

+ 70 km. U.S. Esna Barrage (control section at 60km.)

++ 10 km. D.S. Aswan High Dam.

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Notation

k = coefficient;

n = coefficient;

Sf = final slope of bed;

Si = initial slope of bed at t = 0;

t = time;

X = length measured along channel from downstream;

Z = elevation of bed

Substituting Eq. 2 into Eq. 1, the equation of the bed profile of a degrading channel is

$$Z = S_f X + (S_i - S_f) X e^{-kt} \quad \ldots (3)$$

Although there is no apparent reason to believe that these relations are different for large values of X, it is unwise to extrapolate data taken from flumes with limited lengths to obtain the value of k. It is mandatory to use field data of the reach in question for determining the coefficient k.

Application

The suggested relationship (Eq. 3) was applied to calculate the rate of degradation in the River Nile (Aswan - Esna) reach. The application of the proposed methodology is divided into two parts; the first part is the data collection, and the second part is the predication one to get the degradation depth at any time.

a- Data Collection :

1. The total length of (Aswan - Esna) reach eliminating the Esna Barrage bakwater curve (60km)[10] = 97 km.
2. The initial bed surface slope[6] = 4.9×10^{-5}
3. The final bed surface slope[6] = 2.9×10^{-5}

The Ministry of Irrigation investigators in 1981[11] and in 1987[12] published controversial records about the depth of degradation which has been occured D. S. Aswan since the closure of Aswan High Dam in 1964. These records are

from 1964 to 1975 Degrad. Depth = 21 cm[11]

from 1964 to 1977 " " = 46 cm[11]

from 1964 to 1979 " " = 58 cm[11]

from 1964 to 1987 " " = 25 cm[12]

Unfortunately, there are not much data available in order to varify these records Therefore, the coefficient k for first 10 years was calculated for (Aswan - Esna) reach from maximum records of the period 1964 - 1979. The value of coefficient k is equal to 0.1613.

b- The Prediction of Degradation Depth :

A Computer programme was designed to calculate the rate of degradation at any distance for (Aswan - Esna) reach. The results are shown in Table 1 and Fig. 2. From Table 1 and Fig. 2, it can be seen that, the rate of degradation is high after the closure of Aswan High Dam, then it progressively decreases with time. The depth of degradation D.S. Aswan after 50 years is 48.25 cm.

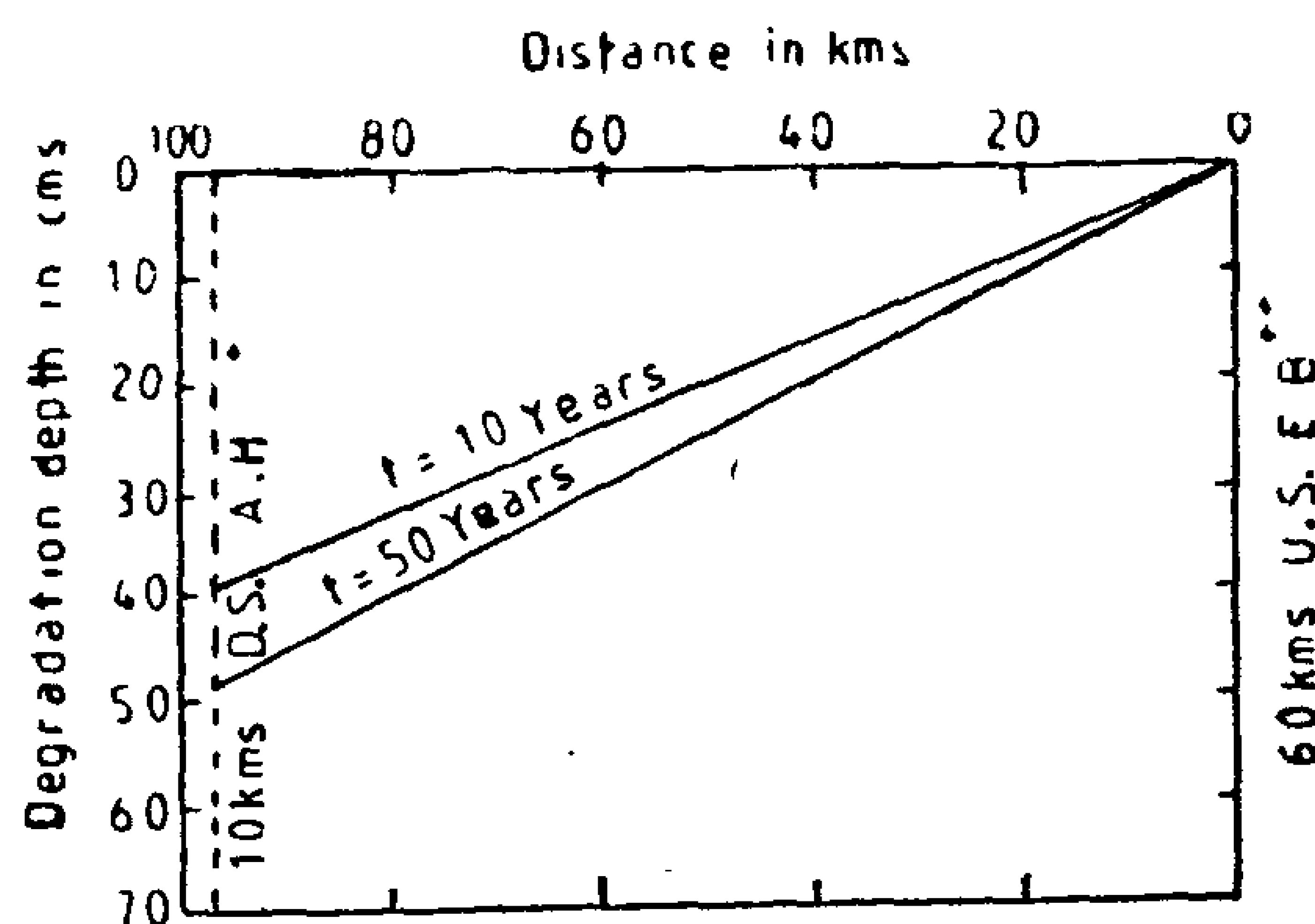


Fig. 2- The River Nile bed profile (Aswan-Esna) reach during degradation process

Conclusions

Many investigations have been carried out on the degradation in the River Nile. All of these studies have not reached accurate results due to the lack in field data A relatiinship to predict the rate of degradation in alluvial channels was suggested. The proposed method was applied to calculate the rate of degradatiin in the River Nile (Aswan - Esna) reach. The presented results were based on controversial data, hence more accurate predictions can be made if more relaible data are available.

THE DEGRADATION IN THE RIVER NILE

Dr. M.M. Salama

Introduction

The problem of degradation in the River Nile has been of considerable importance after the construction of the High Dam. Many investigations have been carried out to predict the depth of degradation since the closure of the Aswan High Dam in 1964. Fathy(2), Mostafa(5), Loutfi and Shalash(4), Simons(8), Wahby(9). Hammad(3), Yassin(10), Salama(7), and Moussa(6) made experimental and theoretical studies on the degradation in River Nile. In general, their investigations were approached on two main fundamental bases, a- critical shear stress appraach and b- emperical formulae based on either field or experimental data. In most of these studies a big gab between their results and field measurements was found.

The main objectives of the present study are: to develop a relationship by means of which the rate of degradation can be computed, and to apply the suggested relationship to the River Nile (Aswan - Esna) reach as a case study.

Analysis

The coordinate system is set as shown in Fig. 1 with S_i and S_f representing the initial and final bed slopes respectively. The boundry and initial conditions to be satisfied are:

1- at $X = 0$, $Z = 0$

2- at $t = 0$, $Z = S_i X$

3- at $t = \infty$, $Z = S_f X$

4- $\partial Z / \partial X > 0$ at all times

An equation found to satisfy all of these conditions is

$$Z = S_f X + (S_i - S_f) n X \quad \ldots\ldots(1)$$

in which n = function of time for a given flow condition and bed material. In addition, at $t = 0$, $n = 1$ and as t tends to infinity n must approach zero.

Equation 1 can be only one of the functions that satisfies all the boundry and initial conditions; therefore, its usefulness must be determined by field data evidences. Bhamidipaty and Shen(1) carried out experimental study to determine the shape of the function n. They found that the following function satisfies both the boundry and initial conditions:

$$n = e^{-kt} \quad \ldots\ldots(2)$$

in which, k is a coefficient depends on initial shear stress due to grain roughness and fluid as well as sediment properties.

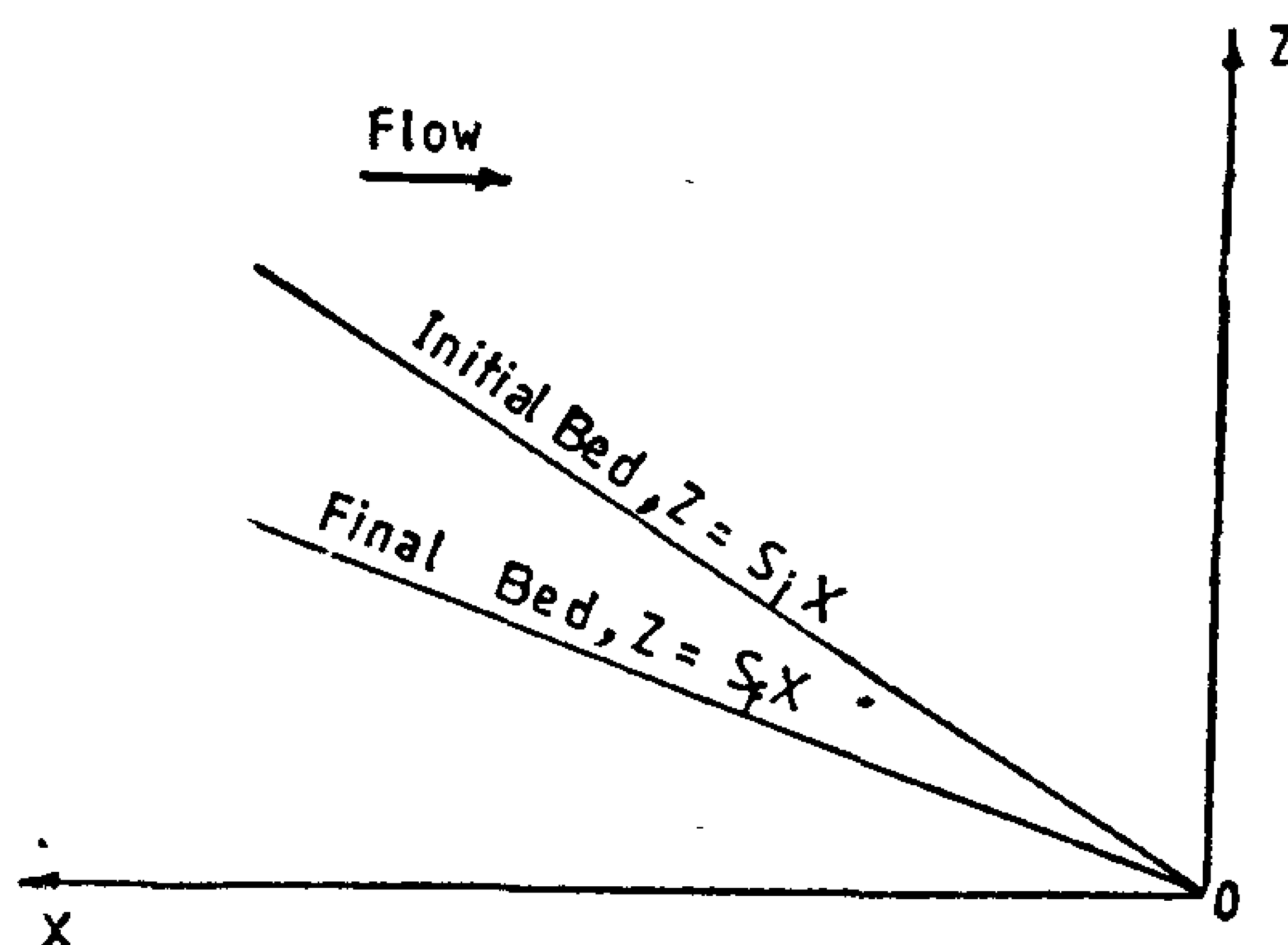


Fig. 1 - Coordinate System

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JOURNAL OF THE EGYPTIAN SOCIETY OF ENGINEERS

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VOL. 27 ISSUE No. 1 1988

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جمعية المهندسين المدنيين
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نبذة عن تطور المواصفات وأسس التصميم واشتراطات التنفيذ في مصر

بقلم الأستاذ الدكتور محمد العدوى ناصف

بدأ وضع المواصفات القياسية المصرية فى الأربعينات . بجمعية المهندسين المصرية بجهود متواضعة وفى مجال محدود جدا من التخصصات الهندسية المختلفة ، وذلك بدافع شخصى من بعض السادة المهندسين المهتمين من ذوى الخبرة العالية ، وكان معظمهم من اساتذة الجامعات المشتغلين بهذه المجالات .

وقد ظهر قبل ذلك بعض المواصفات الخاصة لبعض المصالح الحكومية مثل مصلحة السكك الحديدية (قسم الكبارى) ومصلحة الطرق والكبارى ، وفى منتصف الخمسينات بدأ نشاط مركز بحوث البناء ــ كجزء من نشاطه ــ بتشكيل عدة لجان لاعداد المواصفات القياسية لبعض مواد البناء وأسس التصميم واشتراطات التنفيذ (الكود) Code of practice للمنشآت المصنوعة من الخرسانة المسلحة والخرسانة سابقة الاجهاد والمنشآت المعدنية بالاضافة الى مجهودات محددة فى مجال ميكانيكا التربة والأساسات ، وفى أوائل الستينات تم الانتهاء من وضع وطبع النسخة الأولى من أسس واشتراطات التصميم للمنشآت الخرسانية والمنشآت المعدنية من خلال مركز بحوث البناء والمتداولة حتى تاريخه .

وفى ذلك الحين نقل نشاط اعداد وتحضير المواصفات القياسية المصرية الى وزارة الصناعة على شكل عدة لجان متفرقة ، وبعد ذلك تم انشاء هيئة التوحيد القياسى بنفس الوزارات لاعداد المواصفات القياسية فى المجالات الهندسية المختلفة والعمل على تطويرها بما يتناسب مع الظروف المحلية .

وفى أوائل السبعينات صدر قرار وزارى من السيد وزير الاسكان بأعتماد أسس واشتراطات التصميم للمنشآت الخرسانية والمعدنية السابق أصدارها بمركز بحوث البناء وأعطيت الصفة الرسمية ، واصبحت نافذة المفعول وواجبة التطبيق بمعرفة الجهات المختصة ولم يتغير المضمون العلمى والتنفيذى عن المحتوى الذى تم أعداده فى أوائل الستينات وحتى تاريخه اى انه لم يحدث اى تطوير بما يتواكب مع المستحدث من العلم والتكنولوجيا ، علما بأنه يجرى فى الدول المتقدمة تعديل تطوير أسس التصميم وأشتراطات التنفيذ (الكود) لتضمينها المستحدث فى هذا المجال وكذا لعمل التعديلات التى ظهرت الحاجة اليها نتيجة التطبيق ويتم ذلك على فترات منتظمة تتراوح بين خمس وسبع سنوات وذلك بخلاف ما قد يظهر من ملحقات فى خلال هذه الفترة لشرح بعض المواضيع أو التعليق عليها ــ أو اقتراحات للدراسة توطئة للتعديلات القادمة ويتم ذلك بواسطة لجان دائمة متخصصة لهذا العمل وغالبا ما تتبع الجمعيات العلمية الهندسية أو الجمعيات الهندسية الفرعية المحلية بالاشتراك مع المهتمين بذلك من مهندسى الصناعة ومعاهد البحوث والجامعات .

تأسيس التصميم واشتراطات التنفيذ المصرية التى تم اعدادها فى أوائل الستينات للمنشآت المختلفة وعلى النحو سالف الذكر مستمرة بنفس الصورة على الرغم من المحاولات المتكررة من بعض المهندسين الذين يعنيهم تطويرها لايجاد السبل لذلك فى الجهات الرسمية ولكن لم تكلل جهودهم بالنجاح الا بقدر محدود فى السنوات الاخيرة حيث تم تدبير بعض الاعتمادات المتواضعة للبدء فى تطويرها سواءا بالنسبة للمنشآت الخرسانية المسلحة العادية أو المنشآت المعدنية والاساسات والمبانى ، وقد صدر قرار وزارى بتشكيل لجنة تنفيذية لمتابعة ذلك . وتم أختيار أحد السادة الاساتذة من كل من هذه التخصصات رئيسا وآخر مقررا لمجموعات العمل من بين بعض اساتذة الجامعات والمعاهد المتخصصة ومن مهندس الصناعة للقيام بهذا العمل وحتى وضعه فى صورته النهائية .

وعلى سبيل المثال فيما يتعلق بأسس التصميم واشتراطات التنفيذ (الكود) Code of practice لأعمال الخرسانة المسلحة فقد تم تشكيل لجنة تنفيذية تشمل مجموعة من ذوى الخبرة المتميزة فى هذا المجال ومن جميع الجهات المختلفة المعنية بذلك لوضع الخطوط العريضة لانجاز العمل المطلوب والمتابعة والمراجعة المدروسة والنهائية ، وانبثق عن هذه اللجنة عدة لجان

فرعية كل منها ذات عدد محدود لكل موضوع من المواضيع التى سيتم تناولها فى الكود المقترح ، علاوة على لجنة هيئة المكتب لمتابعة الرموز والمصطلحات وكذا لجنة الصياغة ولكل من هذه اللجان الصلاحية بالاستعانة بمن تراه من المتخصصين وذوى الخبرة .

وبدافع من الشعور بالمسئولية العلمية والقومية والوفاء للزملاء فى المهنة ومجال التخصص ودون الربط بين أهمية وضخامة العمل المطلوب انجازه بدأت هذه اللجان فى أن واحد عملها بمجهودات مكثفة متواصلة بغية تحقيق الهدف المنشود ، آخذين فى الحسبان ما هو متاح من كودات مماثلة فى العديد من الدول الغربية والشرقية المتقدمة والنامية مع الاخذ فى الاعتبار الظروف والخبرات المحلية ومراعاة أن يتم التحديث والتطوير على مراحل تدريجية متتابعة بحيث يسهل على مهندسى التنفيذ متابعتها وتطوير أعمالهم تدريجيا بما يتمشى والمطالب المستحدثة للعصر .

وتقوم لجنة الصياغة بالتنسيق والربط للبيانات المعدة بواسطة اللجان الفرعية المختلفة وكذلك العمل على وضع النصوص بقدر المستطاع فى صياغة الكود ، ثم يعاد لكل لجنة ما يخصها للدراسة وابداء الاقتراحات التى تتراءى لها فيما أعدته من بيانات بعد قيام لجنة الصياغة بمهمتها، وعلى ضوء ذلك يتم اعداد المسودة الأولى للكود ليتم طرحها لأعضاء اللجان المختلفة للدراسة والمناقشة وابداء الرأى وعلى ضوء ذلك تقوم لجنة الصياغة باعداد المسودة النهائية والمقترح توزيعها ونشرها بين جميع المهتمين والمشتغلين فى هذا المجال بالجامعات والمعاهد ومؤسسات الصناعه والتشييد لفترة كافية للدراسة وابداء الرأى ، ونأمل أن يواكب ذلك نشاطا ملموسا من خلال جمعية المهندسين المصرية والجهات المماثلة لشرح مضمون الكود المقترح وما أشتمل عليه من عناصر مستخدمة وعلى ضوء ما تسفر عنه المراجعات للمسودة النهائية سيتم الوصول بالكود المصرى الى صورته النهائية .

وهناك اتجاه لاعداد ملحقات لشرح وتوضيح ما تم استحداثه من بيانات ومعلومات فى الكود الجديد لجعل استخدام هذا الكود متيسر والفائدة أعم وأشمل بأذن الله والله الموفق .

اصدار أصول العمل الهندسى

نشاط جدير بجمعية المهندسين المصرية •

بقلم الأستاذ الدكتور على محمد كامل

لماذا أصول العمل الهندسى ؟

حيثما نجح مجتمع فى نقل التكنولوجيا ليسيطر بواسطتها على ظروف بيئته الطبيعية استلزم ذلك اكتساب أفراده جرعة مناسبة من المعلومات والسلوكيات والمهارات عن طريق الخبرة الناجمة من الممارسة تعينهم على استيعاب مفاهيم التكنولوجيا والعمل بها .

وفى مجال الهندسة تعارفت الهيئات المعنية بنقل التكنولوجيا وتطبيقها على اصدار « أصول عمل » تتناول السلوكيات والمهارات التى تلزم لتحقيق التطبيقات التكنولوجية عن طريق تنميط قواعد الحلول الهندسية فى اطار نظم التقييس السائدة فى بيئتها والقيام بتقييم جدواها ، حتى يتسنى للمشتغلين بانجاز تلك التطبيقات التعرف على كيفية اختيار الحلول المناسبة ومن ثم اتخاذ القرارات الهندسية المؤهلة لتنفيذها بنجاح . وترتب على ذلك تمكين المجتمع من حسن استخدام التكنولوجيا للنهوض بمستوى معيشته .

لماذا جمعية المهندسين ؟

من الطبيعى ان يتضافر على اصدار « أصول العمل الهندسى » هيئات وأفراد اكتسبوا الخبرة بممارستها والقدرة على اختيار المجالات التى تصلح لتطبيقها، ومواصلة مراجعتها وتجديدها بما يكفل مواكبة تقدم التكنولوجيا المناسبة لظروف المجتمع الذى تصدر لأجله .

كما انه من الطبيعى أن تحتضن هذا النشاط فى مصر « جمعية المهندسين المصرية » التى انشئت منذ أكثر من ستين عاما ومازالت تتولى الريادة فى التخصصات الهندسية المتعددة التى تضمها بين جنباتها ، ويؤهلها لذلك :

١ — استقرارها على مدى تاريخها الطويل فى أداء رسالتها نحو العشيرة الهندسية دون ان تقلقها التغيرات فى الشخصيات العامة أو النظم السياسية أو الاجتماعية .

٢ — قدرتها على حشد المتخصصين فى مختلف الفروع الهندسية من أساتذة الكليات والخبراء فى الهيئات الحكومية وفى مواقع الانتاج الهندسى ممن يمثلون مختلف الاتجاهات المعنية بموضوع الاصول ويحرصون على تكاملها ويقبلون على ذلك بدافع من ولائهم لمهنتهم وحرصهم على تقدمها .

٣ — امتلاكها وسائل الاعلام من مجلات ونشرات علمية ومكتبات وامكانات تنظيم حلقات دراسية وندوات ومؤتمرات تعرض فيها مشاريع أصول العمل وتتلقى عن طريقها تعليقات الدوائر الهندسية المعنية على تلك الأصول ثم صياغتها فى صورة معتمدة ، واعادة النظر فيها كلما اقتضى الأمر .

ما هو أسلوب العمل المقترح ؟

١ — تقوم الجمعيات التخصصية العاملة تحت لواء الجمعية بتقديم قوائم بأسماء اعضاء مجموعات اصدار اصول العمل فى مختلف دروب العمل الهندسى الى مجلس ادارة الجمعية لاعتمادها .

٢ — تقوم هذه المجموعات باختيار مواضيع الأصول التى يحتاج اليها العمل الهندسى فى مصر ، وترتيب أولوياتها .

٣ — تقوم المجموعات بالعمل فى اصدار الاصول المختارة فى اطار الميزانيات المتاحة لها .

٤ — تعرض مشاريع الاصول التى تنجزها المجموعات فى وسائل اعلام الجمعية ، وتدعى الجهات المعنية الى التعليق عليها .

٥ — تصدر الجمعية الاصول التى تعتمد بعد التعديل وتحتفظ لنفسها بحقوق النشر .

٦ تنوه الجمعية بالمجهودات الممتازة لاعضاء مجموعات العمل فى الاصول وتحيط جهات عملهم بذلك التقدير .

تقسيم مصر الى أقاليم سياحية

جمعيـة التخطيط

بذلت محاولات عـدة لتقسيم مصر الى اقاليم سياحية ، وتتناول هذه الدراسـة ثلاثة اقتراحات أعـدت بمعرفة وزارة السـياحة والدكتور حسـين كفافى والدكتور أحمـد العيسوى ، وفيما يلى التقسيمات المقترحة :

الاقتراح الأول ـ وزارة السياحة :

قام مجموعة من المسـئولين عن التخطيط السياحى فى وزارة السياحة بتقسيم مصر الى تسعة اقاليم سياحية هى :

١ ـ اقليم القاهرة

ويضم محافظات القاهرة والجيزة وبنى سويف والفيـوم .

٢ ـ اقليم الاسكندرية

ويضم محافظة الاسكندرية التى تمتـد من ابى قير شرقا الى العجمى غربا .

٣ ـ اقليم الدلتا

ويشمل محافظات الوجه البحرى من الساحل الشمالى لها المطل على بحـيرة البرلس والبحر المتوسط الى الجنوب شمال القاهرة .

٤ ـ اقليم الصـعيد

ويشمل محافظات المنيا واسيوط وسوهاج وقنا واسوان حتى الحـدود الجنوبية المتاخمة للسـودان .

٥ ـ اقليم قناة السويس

ويشمل محافظات بورسـعيد والاسماعيلية والسويس .

٦ ـ اقليم الساحل الشـمالى الغربى (اقليم البحر الابيض المتوسط)

ويضم محافظة مطروح .

٧ ـ اقليم الواحات (اقليم الصـحراء الغربية)

ويضم واحات سـيوه والبحرية والفرافرة والخارجة والداخلة .

٨ ـ اقليم سـيناء :

ويضم محافظتى سـينا الشمالية وسـينا الجنوبية .

٩ ـ اقليم البحر الأحمر :

ويضم محافظة البحـر الاحمر ويمتـد من جنوب السويس حتى نهاية الحـدود المصرية الجنوبية عند السودان .

ويوضح شكل رقم (١) اقتراح وزارة السياحة

الاقتراح الثانى ـ دكتور حسين كفافى (رسالة دكتوراه ـ ١٩٨٦) :

يقول صـاحب الاقتراح :

ان التصور الشامل لاقاليم التنمية السياحية يجب ان تتوفر لها الاركان الثلاثة الآتية :

اولا ـ التكافل الاجتماعى لكل اقليم :

وهو التكافـل بين فئات وطبقـات وانواع ومستويات المجتمـع المختلفـة ، بمعنى توافر الامكانات البشرية لخلق فرص العمـل اللازمة لكافة مستويات النشـاط السياحى الذى يكفل مجتمع سياحى قوى ومتكامل له ظهير اجتماعى ذو نسيج متين .

ثانيا ـ التكامل الاقتصادى لموارد الاقليم :

لضمان ان يكون فى أى اقليم او اقليم ثانوى مقومات اقتصـادية للاكتفـاء الذاتى ، تظهـير اقتصادى قوى لا يمكن تحطيمه لأى ظـروف طارئة .

ثالثا ـ الترابط الطبيعى لامكانيات الاقليم :

ترابط اجزاء الاقليم او من ناحية اخـرى التوافق بين مراكز الجذب الطبيعية من مزارات طبيعية بغرض خلق فرص للسياحة الترويحية ، ومزارات أثرية ودينية للسياحة الثقافية ، بما يحقق الانتقال بين المراكز المختلفـة ، بوسـائل النقل البرى لتكفـل رحلات سـياحية متنوعة

شكل رقم (١) تقسيم مصر الى تسع اقاليم سياحية ـ اقتراح وزارة السياحة .

ومحببة ومريحة ، ولضمان احكام الادارة فى فى تنفيذ المراحل المختلفة من خطط التنمية :

من واقع التكافل الاجتماعى والتكامل الاقتصادى والترابط الطبيعى توصى الدراسة بتحديد الاقاليم السياحية بمساحات لكل اقليم فى المتوسط ٥٠٫٠٠٠ خمسين الف كيلو متر مربع اى مساحة من الأرض على شكل مربع طول ضلعه ٢٢٠ ك.م. او مساحة من الارض على شكل دائرة طول نصف قطرها ١٢٥ ك.م والتى تضم الاقاليم السياحية الثانوية ، وهذه بدورها تضم مراكز سياحية ، بما يسهل التنقل بين المواقع بعضها البعض ، من مزارات أثرية وترفيهية ، بوسائل الانتقال البرية ، فى زمن يناسب الرحلة اليومية فى المتوسط ، وقدره ٩٠ دقيقة وبما يحقق احكام السيطرة والادارة فى مراحل التنفيذ المختلفة لأقاليم التنمية .

وفيما يلى الاقاليم المقترحة :

أ ـ اقليم القاهرة :

ويضم محافظات القاهرة وبنى سويف والفيوم والسويس والقليوبية والمنوفية ، ومساحة هذا الاقليم حوالى ٤٠٫٠٠٠ أربعين ك.م٢ ، وينقسم الى الاقاليم الثانوية الآتية :

(أ) القاهرة الكبرى : بمساحة قدرها ٨٫٥٠٠ ك م٢ .

(ب) الفيوم شاملة بحيرة قارون : بمساحة قدرها ٨٫٥٠٠ ك.م٢ .

(جـ) بنى سويف شاملة الوادى : بمساحة قدرها ٨٫٥٠٠ك.م٢ .

(د) السويس : وتشمل سواحل البحر الاحمر الشمالية بمساحة قدرها ٨٫٥٠٠ك.م٢.

٢ ـ اقليم الدلتا :

ويشمل محافظات الاسكندرية والبحيرة وكفر الشيخ والغربية ودمياط والدقهلية والشرقية ، وتبلغ مساحة هذا الاقليم حوالى ٠٠٠ر٤٠ كم٢ ، وينقسم الى الاقاليم الثانوية الآتية :

(أ) الاسكندرية ورشيد : بمساحة قدرها ٥٠٠ر٨ كم٢ .

(ب) شمال الدلتا (البرلس وبلطيم) : بمساحة قدرها ٥٠٠ر٨ كم٢ .

(جـ) شرق الدلتا (الدقهلية والشرقية) بمساحة قدرها ٥٠٠ر٨ كم٢ .

(د) وسط الدلتا (الغربية والمنوفية والقليوبية) بمساحة قدرها ٥٠٠ر٨ كم٢ .

٣ ـ أقليم المنيا :

ويضم محافظات المنيا واسيوط والجزء الشمالى من صحراء الشرقية حتى ساحل البحر الأحمر ، وتبلغ مساحة الاقليم حوالى ٠٠٠ر٥٥ كم٢ .

وينقسم الى الاقاليم الثانوية الآتية :

(ا) المنيا : ومساحة حوالى ٠٠٠ر٢ كم٢

(ب) اسيوط : ومساحة حوالى ٠٠٠ر٨ كم٢ .

(جـ) ساحل البحر الاحمر : ومساحته حوالى ٠٠٠ر١٠ كم٢ .

٤ ـ اقليم قنا (أو الأقصر) :

ويضم محافظات سوهاج وقنا والجزء الاوسط من الصحراء الشرقية حتى ساحل البحر الاحمر ، ومساحة هذا الاقليم حوالى ٠٠٠ر٦٥ كم٢ .

وينقسم الى الاقاليم الثانوية الآتية :

(أ) سوهاج : ومساحته حوالى ٠٠٠ر١٢ كم٢ .

(ب) الأقصر : ومساحته حوالى ٠٠٠ر١٢ كم٢ .

(جـ) ساحل البحر الاحمر : ومساحته حوالى ٠٠٠ر١٥ كم٢ .

٥ ـ اقليم اسوان :

ويشمل محافظة اسوان وجنوب الصحراء الشرقية حتى ساحل البحر الاحمر ، ومساحة هذا الاقليم حوالى ٠٠٠ر٩٠ كم٢ ، وينقسم الى الاقاليم الثانوية الآتية :

(أ) ادفو : ومساحته حوالى ٠٠٠ر١٠ كم٢

(ب) اسوان : ومساحته حوالى ٠٠٠ر٨ كم٢ .

(جـ) بحيرة السد العالى : ومساحته حوالى ٠٠٠ر٢٠ كم٢ .

(د) ساحل البحر الاحمر : ومساحته حوالى ٠٠٠ر٢٠ كم٢ *

٦ ـ أقليم الواحات :

ويضم الواحات البحرية والفرافرة والداخلة والخارجة ، ومساحته حوالى ٠٠٠ر٦٠ كم٢ ، وينقسم الى الاقاليم الثانوية الآتية :

(أ) الواحة البحرية : ومساحته ٠٠٠ر٥ كم٢ .

(ب) واحة الفرافرة : ومساحته ٠٠٠ر٥ كم٢ .

(جـ) الواحة الداخلة : ومساحته ٠٠٠ر٥ كم٢ .

(د) الواحة الخارجة : ومساحتة ٠٠٠ر٥ كم٢ .

٧ ـ اقليم الساحل الشمالى :

ومساحته حوالى ٠٠٠ر٨٠ كم٢ ، وينقسم الى ثلاثة اقاليم ثانوية هى :

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* لم تظهر حدود هذا الاقليم الثانوى على شكل (٢ ـ ١) .

(أ) السلوم : ومساحته حوالى ١٥٫٠٠٠ ك٠م٢ .

(ب) سيوه : ومساحته حوالى ١٠٫٠٠٠ ك٠م٢ .

(ج) مطروح : ومساحته حوالى ١٠٫٠٠٠ ك٠م٢ .

٨ ــ اقليم سينا :

ويشمل شبه جزيرة سيناء بمحافظتيها ، ومساحة هذا الاقليم $\frac{1}{6}$ سدس مساحة مصر ، أى حوالى ٦٠٫٠٠٠ ك٠م٢ : وينقسم الى الاقاليم الثانوية الآتية :

(أ) ساحل العريش : ومساحته ٥٫٠٠٠ ك٠م٢ .

(ب) ساحل العقبة : ومساحته ٥٫٠٠٠ ك٠م٢ .

(ج) خليج السويس : ومساحته ٥٫٠٠٠ ك٠م٢ .

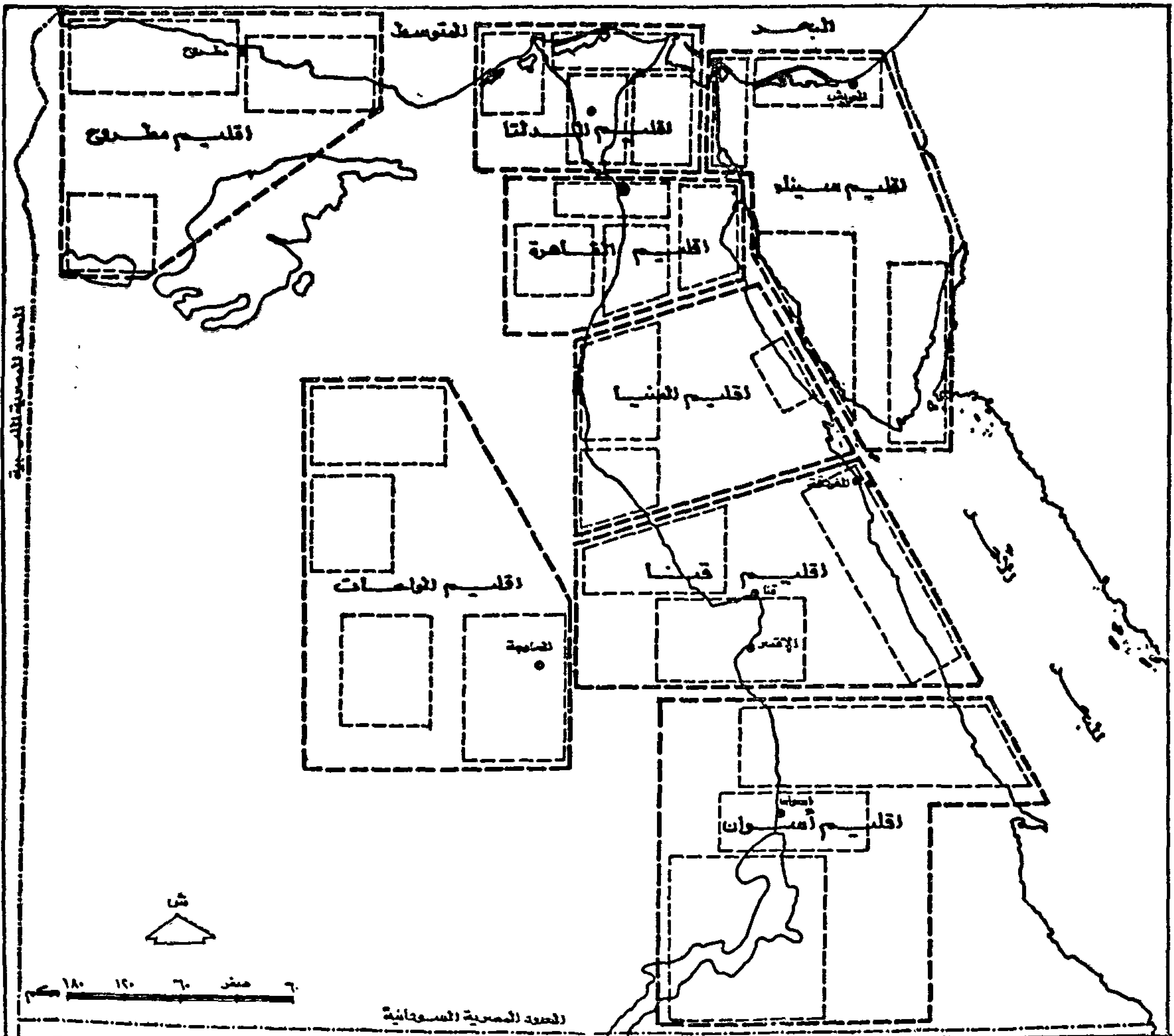
(د) قناة السويس : ومساحته ٥٫٠٠٠ ك٠م٢ .

ويوضح شكل رقم (٢ــأ، ب) هذا الاقتراح (المقدم من د/ حسين كفافى) .

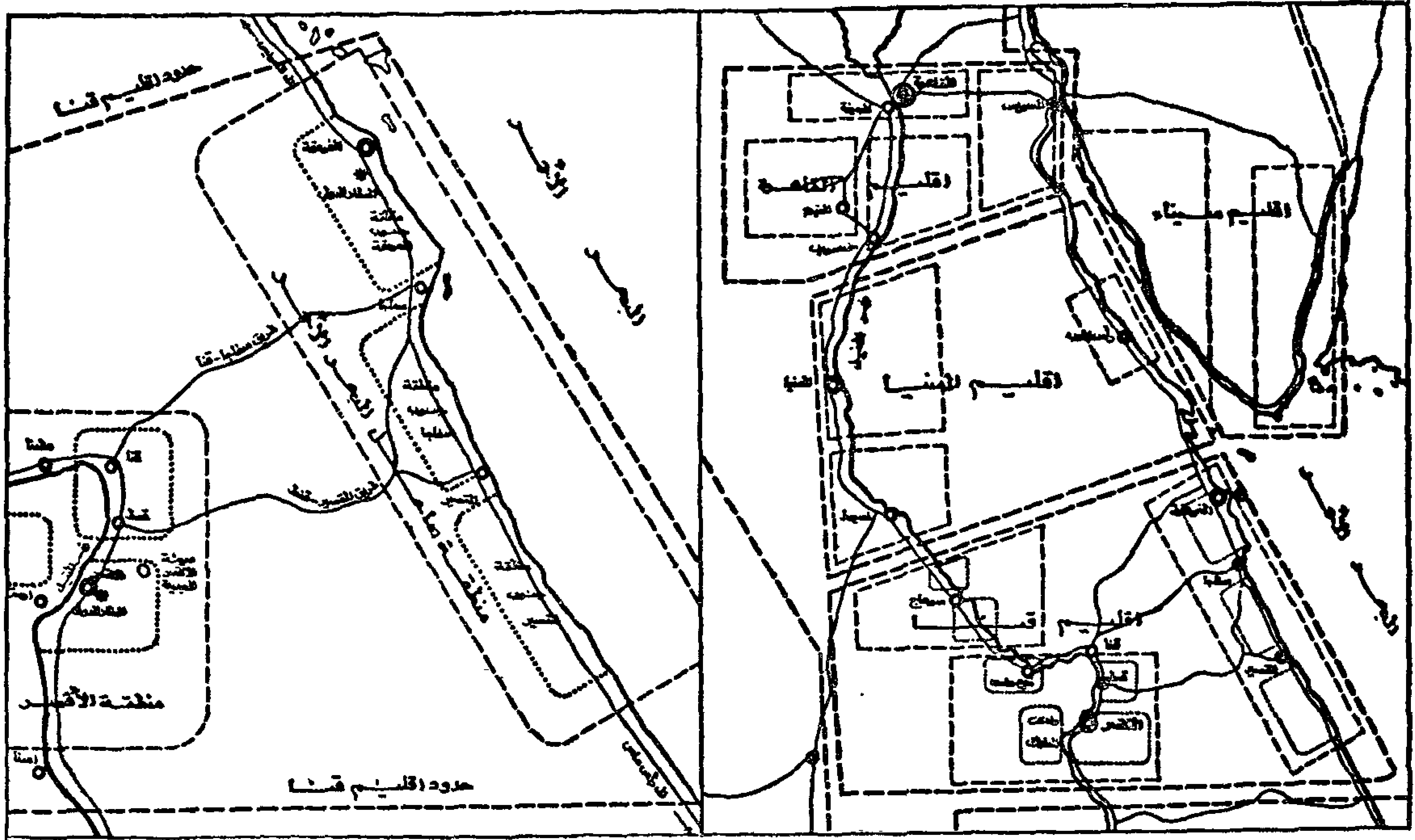
الاقتراح الثالث ــ دكتور أحمد العيسوى (رسالة دكتوراه ــ ١٩٨٧)

يقول صاحب الاقتراح :

تم رسم الخريطة المقترحة للتنمية السياحية الشاملة حتى عام ٢٠١٠ ، وذلك بتقسيم مصر الى قطاعات متكاملة نوعيا ، ومتزنة حجما بأسماء تدل على طبيعة كل قطاع ، وخلفيته التاريخية . وبحيث يحقق كل قطاع منها المستهدف من خطة التنمية السياحية خلال سنوات الخطة ، ويقسم كل قطاع متكامل الى ثلاثة اقاليم سياحية نوعية ، بحيث يكون لكل اقليم صفة اساسية فى الجذب السياحى (متجانس) وترتبط هذه الاقاليم الثلاثة بكل قطاع بعوامل الربط المختلفة لانجاح خطة التنمية وقد روعى أن تتحقق فى هذه الاقاليم الاسس التالية :



شكل رقم (٢ ــ أ) تقسيم مصر الى تسع اقاليم سياحية ــ حسين كفافى رسالة دكتوراه .



شكل رقم (٢ ـ ب) بعض الاقاليم السياحية : القاهرة والمنيا وقنا (اليمين) وكذا اقليم قنا ومنطقة ساحل البحر الأحمر ومنطقة الاقصر (الشمال) ـ حسين كفافى ـ رسالة دكتوراه .

١ ـ اسس توطن النشاط السياحى .

٢ ـ اسس توزيع المراكز السياحية والمساحة الاقليمية لكل قطاع .

٣ ـ نقاط ارتكاز التنمية السياحية ، (المدن السياحية الرئيسية) .

٤ ـ استغلال الكثافات السكانية سياحيا بمناطق تركز السكان .

٥ ـ الواجهات الساحلية ومدى تأثيرها لكل قطاع .

٦ ـ ثلاثية المحاور (الحضارية ، الساحلية ، الصحراوية) فى خلق أنماط سياحية جديدة .

٧ ـ محددات طبيعية وادارية للاقاليم التخطيطية لسهولة تنفيذ خطة التنمية .

وفيما يلى القطاعات المقترحة :

١ ـ قطاع ماريا :

وهو القطاع الشمالى للجمهورية ، ويضم الدلتا ، الاسكندرية ، مطروح حتى سيوه ومنخفض القطارة جنوبا ويحتوى على ثلاثة اقاليم نوعية هى :

(أ) الاقليم الحضارى : ويشمل غرب بور سعيد والاسكندرية والدلتا حتى حدود القاهرة الكبرى جنوبا .

(ب) الاقليم الساحلي : ويشمل الجزء الشمالى من الدلتا ، والساحل الشمالى الغربى حتى حدود السلوم غربا بعمق حوالى ٤٠ كم .

(جـ) الاقليم الصحراوى : ويشمل المنطقة الصحراوية غرب الدلتا حتى واحة سيوه وحدود مصر الليبية .

ويتميز القطاع بطول سواحله وفترته المناخية التى تصل الى ثمانية أشهر .

٢ ـ قطاع ممفيس :

وهو القطاع الأوسط من الجمهورية، ويضم (القاهرة الكبرى ، الفيوم ، بنى سويف ، المنيا، والواحات البحرية ، بالاضافة الى قناة السويس وسيناء) ، ويحتوى على ثلاثة اقاليم نوعية هى :

(أ) الاقليم الحضارى : ويشمل القاهرة الكبرى وبنى سويف والمنيا .

(ب) الاقليم الساحلى : ويشمل مدن السويس والاسماعيلية وسيناء الشمالية والجنوبية .

(جـ) الاقليم الصحراوى : ويشمل الفيوم والواحات البحرية .

ويتميز القطاع بتكامل فترته المناخية لتصل فى بعض أقاليمه الى ١٢ شهرا ، والبعض الآخر الى تسعة أشهر ، بالاضافة الى تعدد منافذه البحرية (البحر الأبيض ، وخليجى السويس والعقبة) .

٣ ـ قطاع طيبة :

ويقع جنوب قطاع ممفيس ، أما حدوده الجنوبية فهى حدود قطاع النوبة ، وهو قطاع عرضى يبدأ من ساحل البحر الاحمر حتى الحدود الليبية ، وتعتبر الأقصر عاصمته السياحية ، ويحتوى على ثلاثة اقاليم نوعية هى :

(أ) الاقليم الحضارى : ويشمل أسيوط وسوهاج وجرجا وقنا .

(ب) الاقليم الساحلى : ويشمل الغردقة وسفاجا ورأس غارب .

(جـ) الاقليم الصحراوى : ويشمل واحتى الفرافرة والداخلة ، ومدينة الخارجة .

ويتميز القطاع عامة بطول الفترة المناخية لتصل الى حوالى ثمانية شهور فى مجمله ، هذا بالاضافة الى تعدد مزاراته الأثرية ، حيث يضم اكبر مجموعة آثار على مستوى الجمهورية .

٤ ـ قطاع النوبة :

ويقع جنوب قطاع طيبة ، حتى الحدود السودانية ، وهو قطاع عرضى ، يحده شرقا ساحل البحر الاحمر ، وغربا الحدود الليبية ، وتعتبر أسوان عاصمته الرئيسية ، ويحتوى على ثلاثة اقاليم نوعية هى :

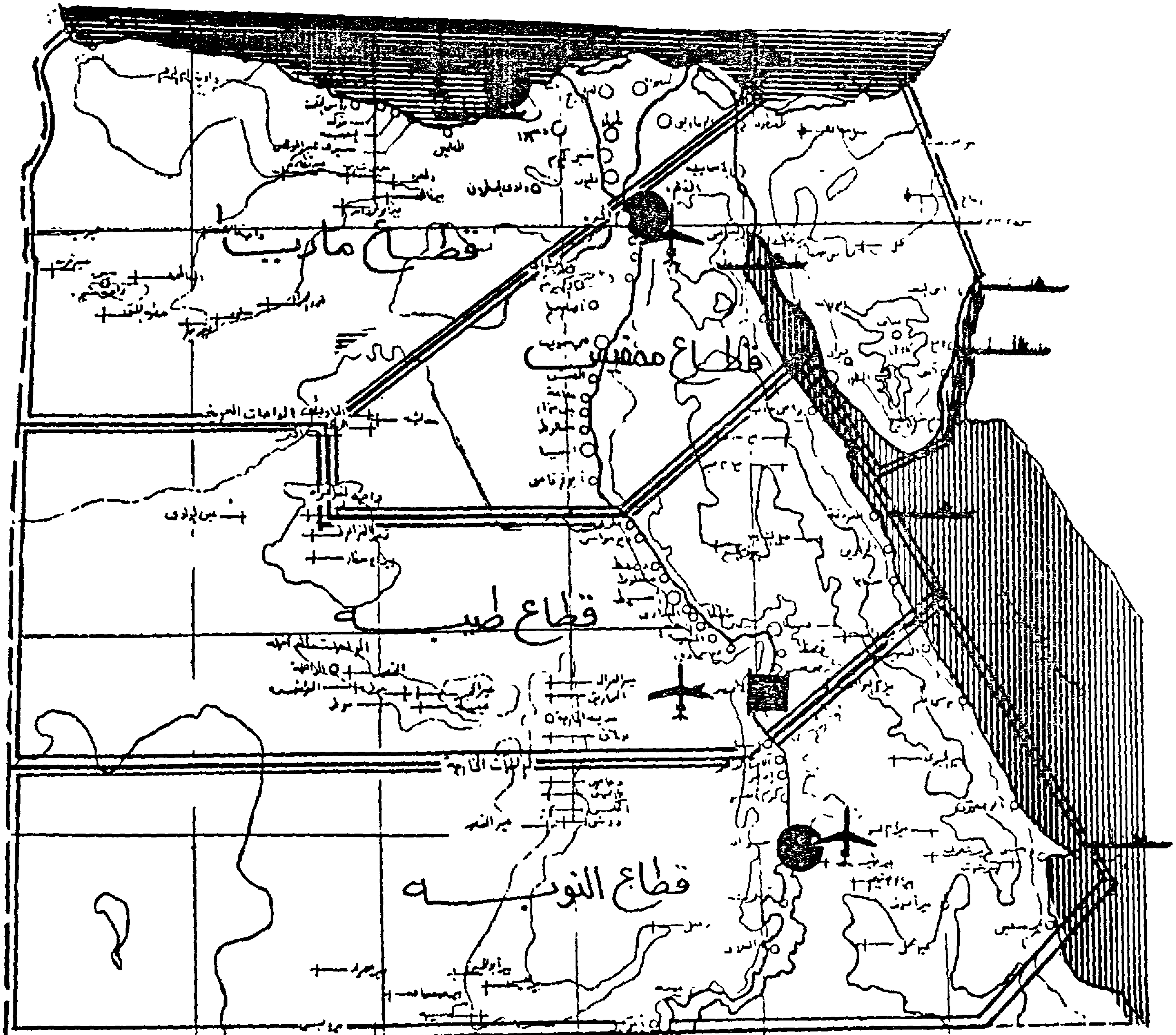
(أ) الاقليم الحضارى : ويشمل اسنا وادفو وكوم امبو واسوان وأبو سنبل .

(ب) الاقليم الساحلى : ويشمل القصير ومرسى علم وابو غصون وبرنيس .

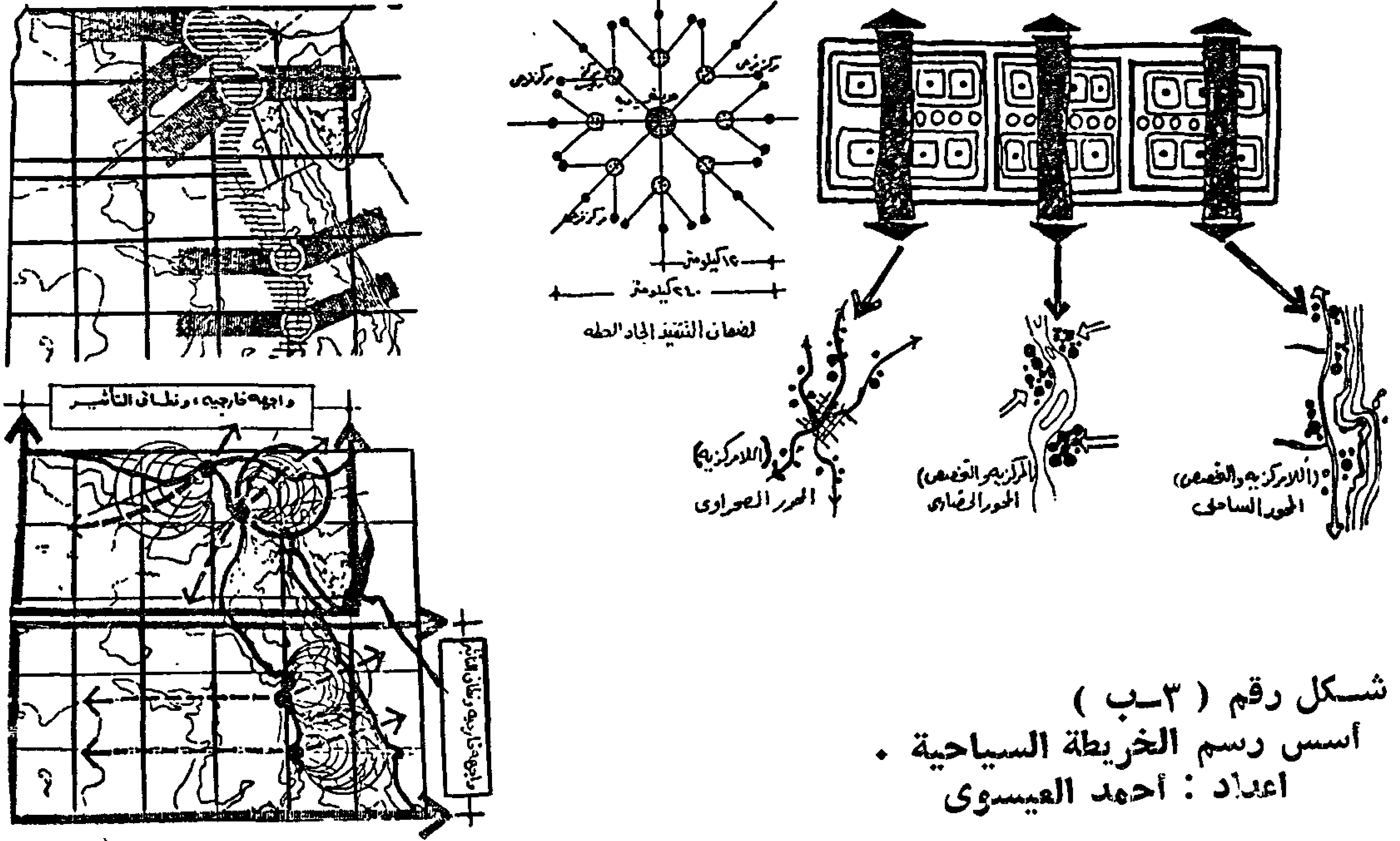
(جـ) الاقليم الصحراوى : ويشمل الجزء الجنوبى من الوادى الجديد ، وأهم مراكزه « باريس » وكسيبة .

ويتميز القطاع بواجهته على ساحل البحر الاحمر ، بالاضافة الى شواطىء بحيرة ناصر ، بخلاف المداخل البرية على الحدود السودانية وطول فترته المناخية لتصل الى حوالى أشهر مع اختلاف نوعيات السياحة به .

ويوضح شكل رقم (٣ـأ،ب) هذا الاقتراح (المقدم من د/ أحمد العيسوى).



شكل رقم (٣ـأ) تقسيم مصر الى أربع اقاليم (قطاعات) سياحية ـ أحمد العيسوى ـ رسالة دكتوراه .



شكل رقم (٣ـب)
أسس رسم الخريطة السياحية .
اعداد : أحمد العيسوى

أسس رسم خريطة التنمية السياحية الشاملة :

وقد ورد فى الاقتراح الثالث الآتى :

روعى أن يحقق فى الاقاليم النوعية الأسس التاليه :

١ ــ ثلاثية المحاور وتوطن النشاط السياحى عليها :

استغلال المحاور الحضرية والساحلية والصحراوية ــ بوجه عام ــ فى خلق أنماط سياحية غير التقليديه طبقا لامكانيات وظروف تنميتها وذلك بأن يتبع بهذه المحاور الثلاثة توطن النشاط السياحى على النحو التالى :

الاقاليم الحضارية ــ ذات الصفة الاثرية يجب أن يتبع فى أسلوب تنميتها « المركزية » فى توزيع خدماتها والتخصص فى النشاط القائم بها « التجانس » .

الاقاليم الصحراويه ــ يجب أن يتحقق فى أسلوب تنميتها « اللامركزية » فى توزيع خدماتها والتنوع فى النشاط ، وذلك بسبب تعدد الأنماط السياحية بها ، وعدم تركز العمران والذى يجعل لهذا الاسلوب الأفضلية فى سرعة التنميه .

٢ ــ أسس توزيع المراكز السياحية والمساحة الاقليمية :

وتنقسم كل من هذه الاقاليم الى اقاليم ثانوية اصغر ، وهكذا تتدرج المستويات حتى مستوى مواقع المشروعات وهذا التقسيم يؤدى الى احكام خطة التنمية ، ويتم اعداد اطارها على شكل برامج انمائية اقليمية .

٣ ــ نقط ارتكاز التنمية : واستغلال الكثافات السكانيه سياحيا :

يمكن اعتبار المراكز الحضرية والمدن السياحية الرئيسية بالجمهورية أهم الركائز التى يمكن الاعتماد عليها فى خطط التنمة القطاعية الاسكندرية ، القاهرة ، الاقصر ، أسوان ــ كما يمكن استغلال الكثافات المرتفعة بالمدن الحضرية، وخاصة المراكز السياحية الرئيسية فى استخدام العمالة المدربة للمناطق السياحية المقترحة ، مما يؤدى الى اعادة تحريك السكان للمناطق ذات الكثافات المنخفضة (محاور التنمية السياحية الجديدة) ، وخلخلة مناطق الكثافات المرتفعة،مع التركيز على تنشيط حركة السياحة الداخلية التى تساعد على سرعة التنمية للسياحة الدولية .

٤ ــ الواجهات الساحلية ومدى تأثيرها :

تؤثر السواحل والشواطىء البحرية فى عمق المنطقة المطلة عليها وخاصة على اتجاهات الحركة داخل المنطقة وخارجها ، وتعمل على تحقيق التنمية السياحية المطلوبة .

٥ ــ محددات طبيعية وادارية :

ان الاقاليم المناخية ، وتطبيقها على الفترات السياحية ، وكذا الحدود الادارية للاقاليم التخطيطية لهى من أهم المحددات لرسم الخريطة السياحية للتنمية الشاملة .

بحث مقدم من الدكتور مهندس / أحمد الفاروق محمد الابيارى
مدرس بقسم الهندسة المعمارية - بكلية الهندسة والتكنولوجيا جامعة حلوان

موضوع البحث :

الشكل والوظيفة فى العمارة المعاصرة

تمهيد :

لعل من أهم الموضوعات التى تشغل بال المعماريين التشكيليين هو الشكل النهائى للمبنى الذى يقوموا بتصميمه : وكثير من المعماريين يحاولون ان يصمموا واجهاتهم أكثر من مرة حتى يحصلوا فى النهاية على الشكل الذى يرضيهم ويرتاحوا اليه .

ومن هنا تبدأ المشكلة .. مشكلة .. تقديم تشكيل جيد ومناسب للواجهات الخارجية للمبانى التى نقوم بتصميمها .

أحب أن أذكر أنه ليس الهدف النهائى من هذا البحث أن نصل الى حل لهذه المشكلة لأنها سوف تستمر وتتطور مع الاجيال الجديدة من المعماريون ولكننا بصفة خاصة نعرض وجهة نظر خاصة بعد طرح الافكار والآراء التى قيلت فى هذا المجال .

عرض المشكلة :

تناول معماريون كثيرون هذا الموضوع وكتبوا فيه الكثير ايضا ولعلنا هنا يمكننا نشرح شيئا مهما .

ان الشكل لا يكون موجودا أصلا الا اذا كان لشىء موجود فيصبح كيان . هذا الكيان يتواجد بناء على طلب أو رغبة ملحة أو احتياج معين لبناء منشأ معين ومثلا على ذلك احتياج الانسان للمسكن أو المصنع .. أى المكان الذى يأوى اليه أو الحيز الذى يمكن ان يمارس فيه عمله أو نشاطه .

هذا المنشأ أو هذا المكان - (الحيز) الذى يحتاج اليه الانسان عندما يتم تصميمه وتنفيذه يخرج لنا على شكل معين ، يتحكم فى هذا الشكل عدة عوامل يمكن تلخيصها فى الآتى :

١ - المكان والبيئة التى يتواجد بها هذا المنشأ .

٢ - المواد المستعملة فى بنائه وأسلوب الانشاء الخاص بكل مادة من خشب ، حجر طوب ، حديد ، خرسانة مسلحة ... الخ .

٣ - النشاط الذى سيؤدى داخل هذا المبنى او الحيز - من دينى - سكنى - رياضى الخ ... وطبيعة البرنامج الموضوع لتأدية هذا النشاط - الأسلوب المعيشى أو الانتاجى .

٤ - الجوانب التى يجب أن يعكسها تشكيل المبنى الخارجى - اقتصادى - وظيفى عاطفى بما فى ذلك من نواحى استاتيكية - كالزخارف - والتعبيرية - والمزاج الشخصى أو القومى .

٥ - حجم المنشأة ومسطحاته الداخلية التى تنعكس مباشرة على تشكيله مثل صالات الحفلات والمسارح والملاعب الرياضية المغلقة أو مبنى مكاتب أو معارض أو سكنى .

هذه العناصر السابقة تكون مؤثرة فى النهاية على شكل المبنى الخارجى وربما فرضت شكل معين على المصمم ، كما يمكن ان نضيف الى ذلك نقطة سادسة تتمثل فى التجهيزات الداخلية المبنى من معدات لتكييف الهواء والمصاعد والسلالم الآلية وخزانات المياة وغرف المحولات ... الخ أو استعمال أسلوب بناء حديث كاستعمال وحدات سابقة الصنع أو مصنعة بالكامل .

كل ذلك مما لاشك له اثر كبير فى تشكيل مبانينا الحديثة وخروجها من حيز الانشاء التقليدى المقيد بمواد وخامات متخلفة الى الاساليب التكنولوجية السباقة الأكثر مرونة وتجاوب مع التطور الاجتماعى والثقافى وفى مختلف مجالات الحياة .

الشكل والوظيفة :

مع بداية القرن العشرين بعد ان أطلق فرنك لويد رايت نظريته المعمارية (العمارة العضوية) ولاقت نجاحا كبيرا ، خرجت العمارة من المجال

التقليدى الى مجـــال الخلق والابداع ثم جاءت بعد ذلك نظرية (لوكوربوزييـه) ، و (ميس) و (والترجروبيوس) صاحب مدرسة الباوهاوس عن الوظيفة فى العمارة (Fuctionalism)

والتى سادت الفكر المعمارى لمدة نصف قرن على الأقل . وتفاعلت النظريتان معا فكل منهما بدى مكملا للآخر .

كانت النظرية الأولى تعنى بالعلاقة بين العناصر فى التصميم (العمارة العضوية) .

وكانت النظرية الثانية تنص على الاقتصـــاد فى المسطحات والعلاقات (الوظيفية) .

تلى ذلك أن أطلق المعماريون مبدأ جديد فى علاقات التشكيل الخارجى للمبانى وذلك بقولهم ان الشكل يتبع الوظيفة (Forme follows function)

ذلك أنه اذا كان هنـــاك برنامج أو موضـــوع جيدا يحتوى مضمون جيدا فان ذلك ســـوف يتبعه أيضا شكلا جيدا بالتباعية .

— ولقياس درجة النفعية فى المبانى وضـعت شروط معينة يمكن تلخيصها فى :

١ — حجم الفراغ ومدى استجابته للنشـــاط المطلوب .

٢ — نوع الفـراغ ومدى ملائمتـــه لهـــذا النشاط .

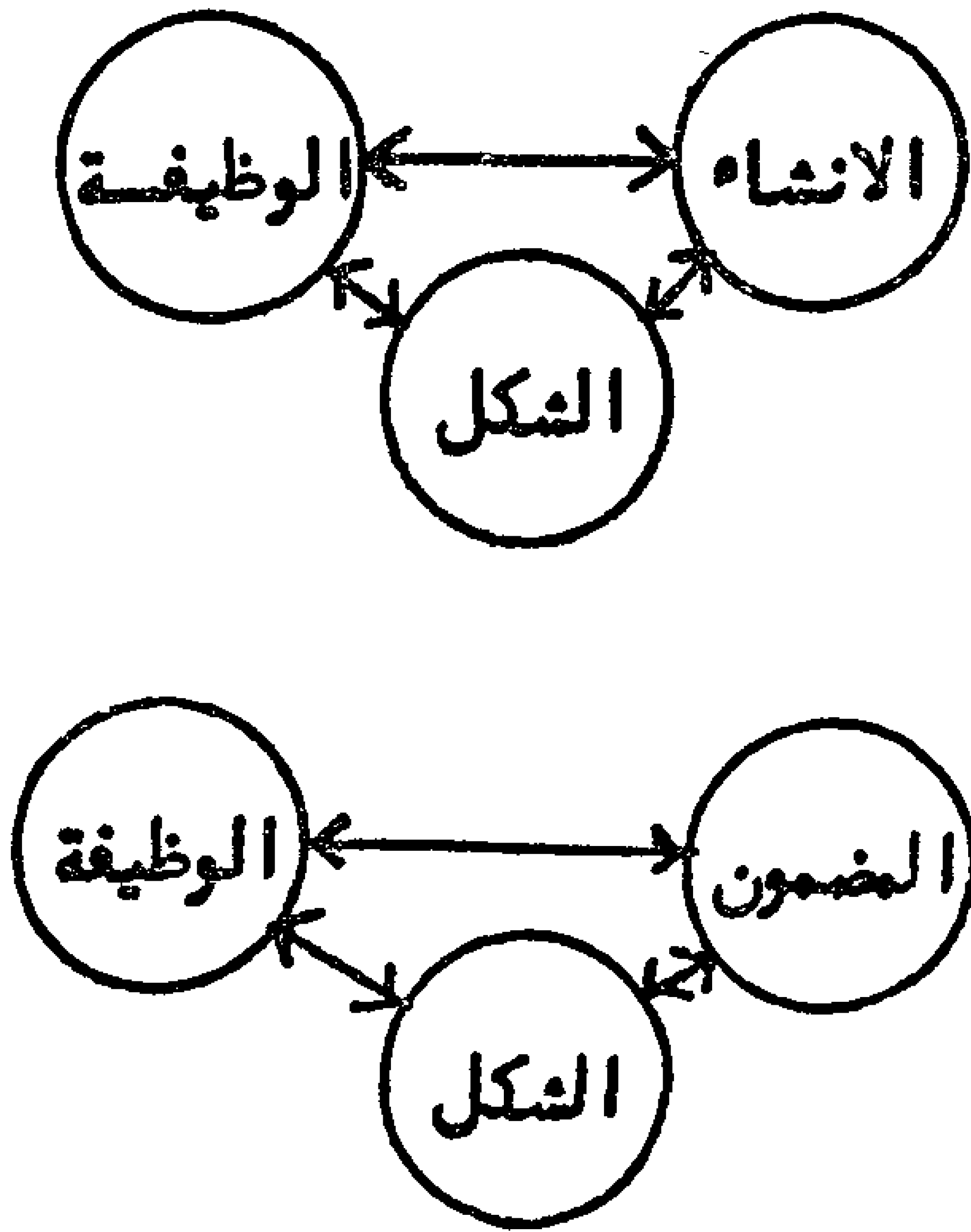
— أما بالنسبة لحجم الفراغ فقد كان أساس قياس درجة الانتفاع به هو ان يكـــون الحجم مناســـب تماما لنـــوع النشـــاط دون زيادة (Lees is more)

— أما من ناحية نوع الفراغ فقد اشـترط أن يقاس بكيفية اشغاله بالعناصر والربط بينه وبين باقى الفراغات بســـهولة وكيفية اداء الحـركة داخله مما ادى الى دراســة جسم الانســان الى المقاييس المناسبة لعناصر شغل الفراغ وتضمينها كتـب « أســـس التصـــميم المعمـــارى » (Date of Architecture) وكذلك التنسيق الدقيق الذى يؤدى الى توازن العناصر المختلفـــة داخل الفراغ فخلق فـــراغ داخلى وخارجى متكامل ومنسجم مع البيئة .

— يأتى بعد ذلك دور الانشاء ليحقق الشكل النهائى للفراغ بدون افتعال أو اضـــافة عناصر غير مطلوبة على أن يكون التعبير الانشائى واضحا فى الشكل النهائى .

— وقد أدى هذا التطبيق لهذه النظـرية الى تشابه فى التصميمات بالرغم من اختلاف الفرض ويبدو أن ذلك كان يحـــدث لأن الفكر المعمارى لنظـــرية الوظيفـــة كان يقضى بضرورة احترام الانشـــاء واعتباره اساسا فى تكوين الشـــكل المعمارى فقد يتكرر اســـتعمال نفس العناصر الانشائية فى بعض المبانى مع اختلاف الفرض أو شكل الفراغ مما يؤدى الى التشابه .

— حدث تطور بسيط لهـــذه النظرية مؤداه الآتى :



* النظـرية الأولى : تتعامل بين ثلاثة عناصر الوظيفة — الشكل — الانشاء .

* النظـرية الثانية : تتعامل بين ثلاثة عناصر هى الوظيفة — الشكل — المضمون وذلك للخروج من تأثير العناصر الانشـــائية فى التشـــكيل واعتبارها جزء من الشكل العام وذلك بقولهم .

« اذا أردنا عمارة جيـــدة فعلينـــا ان نأتى بالمضمون أو محتوى — أو برنامج جيد » ويعنى ذلك ان الشكل هو انعكاس لشىء جيد بالأصـــل فمادام المضمون جيد فانه سيكون جيدا وبحث بعد ذلك المعماريون عن توصيف لكل من الوظيفة والشكل والمضمون كالآتى :

١ — المضمون الجيد :

اذا اردنا ان نحقق المضمون الجيد أو المحتوى الجيد فذلك يعنى ان يكون مدعم بحركة التطور الاجتماعى فى الحاضر فى الحاضر والمستقبل وذلك

يعنى ان التصميم يجب ان يستطيع ان يتقبل كما فى مدرسة (الميتابوليزم والارشيجرام) .

فالمحتوى الجيد مهما جرى عليه من تعديلات او اضافات فانه فى النهاية حصيلته الشكل .. كما ان الشكل بعد ان أصبح فكرة يبتعد عن اصله أى الوظيفة التى أوجدته من خلال المضمون والذى وجد أصلا ليعكس مكونات ذلك المضمون ليدخل الدورة مرة اخرى فى دور التكوين بمحتوى أو مضمون جديد لتوليد شكل جديد من شكل الى شكل آخر بسبب مطالب جديدة .

وبذلك أمكن وضع معايير جديدة تسهم فى تطوير التخطيط والتكوين المعمارى تعكس مفاهيم اجتماعية وتشكيلية جيدة .

(٢) الشكل الجيد :

لفترة طويلة كانت المبادىء والمعايير المستعملة فى الطرز المعمارية هى الشكل ذاته حتى اصبح اظهار هذه القواعد (النسب ـ التناظر ـ الايقاع)
اظهار هذه القواعد (النسب ـ التناظر ـ الايقاع
التنوع ـ التناغم ـ التكرار ـ القطاع الذهبى والتصحيح النظرى ـ الانتاسيس) وغيرها من مبادىء التكوين هى التكوين ذاته . ولكن مبادىء التكوين منفرده أو مجتمعة هى التى يتألف منها الشكل وهذه القواعد هى التكنيك الذى بواسطته يتم تأليف الشكل . أما الشكل فهو الذى ينقل المحتوى الفكرى الى مادة حقيقية تظهر لنا . أى مكونات الشكل منها المادية والنفعية والوظيفية والعاطفية عندما تتفاعل هذه المكونات فى عقل الانسان تتحول الى محتوى فكرى يظهر لنا يتفاعل العقل مع المادة الخام فيولد الشكل ويصبح مادة حقيقية ، وان مبادىء التشكيل هى التكنيك الذى يساهم فى انتاج الشكل على صورته النهائية وهى بذلك جزء من (المضمون ـ المحتوى) الجيد ومكمل له .

الوظيفة النفعية :

الوظيفية فى العمارة تتضمن أمور كثيرة منها الناحية الانشائية التى يمكن أن يكون لها تأثير فى الشكل كجزء من التكوين الشكلى اذا تفاعلت وأخرجت لنا تكوينات هندسية لنا كشكل . (مثل المعارة القديمة والاسلامية) .

ـ الوظيفة كمفهوم نفعى متعلق بتحديد حجم الفراغ ونوعه ـ كمحتوى يتولد منه الشكل فيحدد إرتفاعه وطوله وعرضه ومتطلباته المادية والتكنولوجية والاجتماعية .

ـ الوظيفية لتحقيق مضمون أو محتوى يتطلب المنفعة منه ان يكون ذا شكل معين مزجرف أو متأنق ـ أو محترم ـ أو بسيط كمطلب اجتماعى يرغب فيه أو يصبوا اليه لسبب أو لآجر ـ فالعمل الفنى لا يظهر الى الوجود الواقعى ما لم يتحول أو ينبثق منه اصلا مضمون قد تجسد فى كيان فيظهر لنا كشكل فالمحتوى لا يتفاعل ولا يتحول ويصبح شكلا ما لم يتكامل ويصبح فكرة ملحة فى عقل المصمم تتطلب الخروج . فهى تتفاعل مع الاسلوب الانشائى والنفعى والشكلى ليخرج لنا الشكل .

الخلاصة :

فى هذه الخلاصة سوف نلخص أفكارنا عن هذا الموضوع .. وليس معنى ذلك التناقض مع هذه هذه الأفكار أو موائمة هذا الفكر الخاص بتلك المدارس لافكارنا ولكنه يتضمن رأى شخصى بحث مأخوذ من دراسة متأنية حول هذا الموضوع وكذلك تجربة عملية فى محاولة التطبيق النظرى ونشرحها فيما يلى :

١ ـ اهتم المعماريون بفلسفة الأعمال الجيدة وأرجعوا أسباب نجاحها الى خطط معينة فى الدراسة أو اتجاهات معينة للمصمم أو القائم على تنفيذها والحقيقة ان ذلك لا يجانبه الصواب لأنه ربما المصمم فى اللحظات الحرجة للتصميم والتى أخرجت فى النهاية مشروعه كان واقع تحت سيطرة فكرة معينة أو مجموعة من الافكار قد تكون بعيدة جدا عن تلك التى نراها فى تصميمه وبذلك يكون السبب الفعلى لاخراج هذه الاعمال الجيدة بعيدا جدا عن نظريات التصميم والتشكيل المعمارى .. بل وهناك بعض المعماريين بعد الانتهاء من عملية التصميم .. ينظر باندهاش الى تصميمه أما فى مرحلة عمل منظور للمبنى أو ماكيت او حتى اعمال التنفيذ وقد يقوم بعمل تعديلات لتصحيح بعض النسب او عمل تشكيل جديد للمبنى .

٢ ـ النقد المعمارى للمشروعات المبنية أو المقدمة فى المسابقات المعمارية او الاعمال المنشورة فى المجلات العلمية كان سببا فى تقدم وتطور الفكر المعمارى وأعطى لنا عطاء سخى فى نظريات العمارة وفلسفة العمارة وأساليب البناء والانشاء ولكنه لم يستطع ان يصل الى تكوين (فكر) وربما ن ضمن ما حاوله المعماريين ان يشرحوا كيف صمم مبنى معين من تلك التى نعرفها مثل كنيسة « رون شان » التى صممها (اوكوربوزيه) أو متحف الفن الحديث (بنيويورك) الذى صممه (فرنك لويد رايت) وفى الواقع انها مسألة أفكار غير حقيقية وقد يكون من الأفضل لو شرح لنا واحدمنهم كيف قام بتصميم هذا المبنى او تلك اللحظات الحاسمة التى ادت الى تصميمه بهذا الشكل بدون الرجوع

الى نظـــريات معمارية لأنه بعد اطـــلاق هذه الصيحات فى التصميم بدأ تعديل النظـــريات المعمارية لتتوائم مع هذه التصميمات او ادخالها كما يقول الفقهاء (تفســـير ما هو قائم وحقيقى وسليم بانه يطابق النظرية تماما) او ان النظرية كانت تعنى فى مضـــمونها نفس الشىء واتـــى المعماريون فأطلقوه .. (اعادة تفسير) .

٣ ـ النظريات التى اطلقها الجيل الثالث من المعمارين لم تأت فى الواقع بجديد ســـوى فى موضوع (مرونة التصميم الداخلى) اما ماعدا ذلك فلا يدخل فى نطاق التحديث لان تصميماتهم اذا امكن تطبيقها على مجتمـــع معين (اليابان) مثلا فانه لا يمكن تطبيقها على كل المجتمعات . أو انشـاء مدينـــة كاملة .. (حلم) الا اذا تخلى المعمارى عن آدميته .

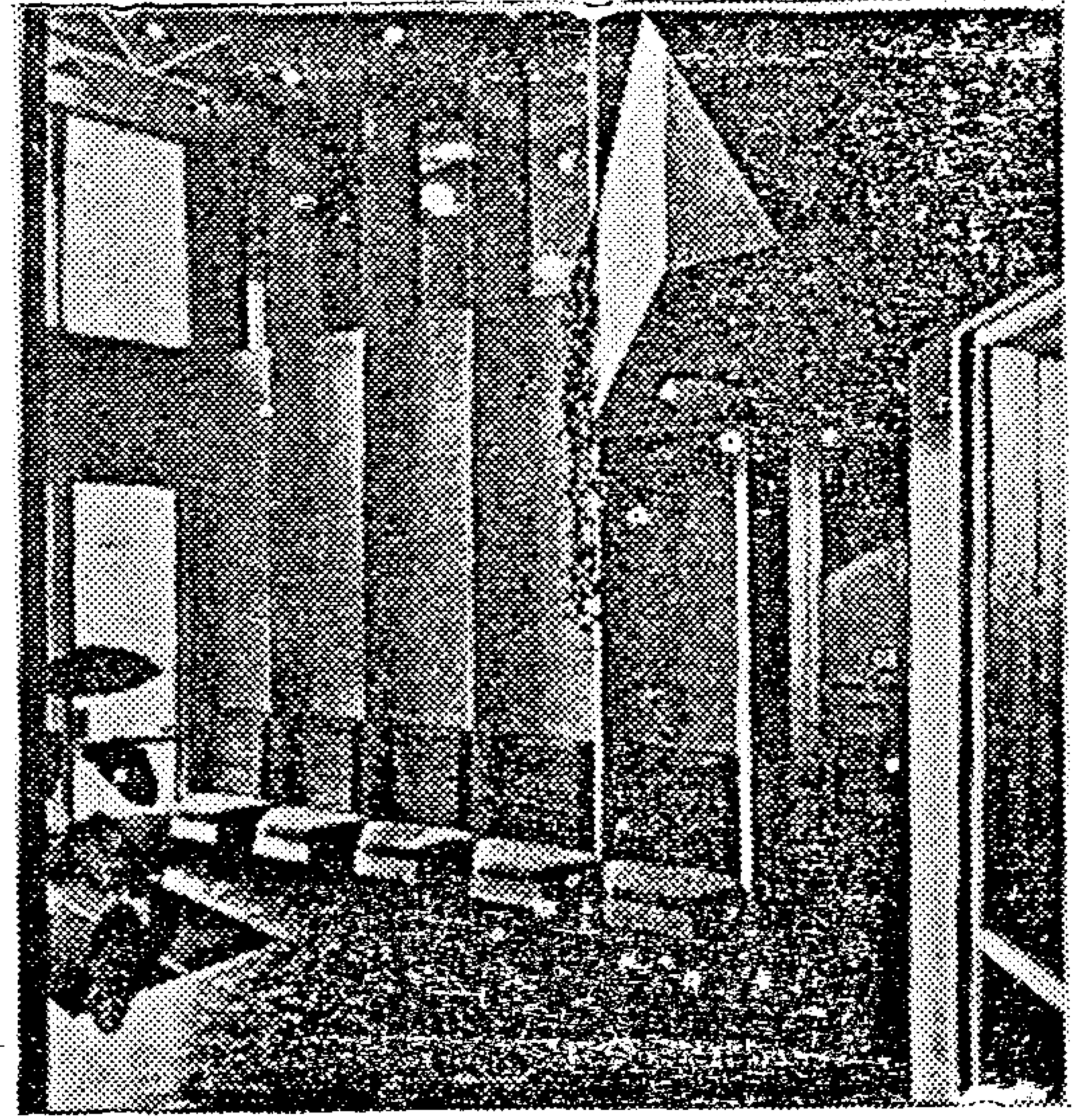
وقد حاول المصممون فى الاتحاد السوفيتى ان يقدموا بعض التصميمات المعمارية فى المـدن العمالية المثالية ولكنهم لم يتمكنوا سوى تطبيق سياسة الامر الواقع وخلق مدن بغيضـــه غير قابله للسكنى .

٤ ـ أما عن رونة الفراغ الداخلى فقد سـبق تطبيق هذا المبدأ فى المبنى الذى صممه (ميس فان دى روه) ســنة ١٩١٤ ثم طبق فى كثير من مبانى المكاتب بعد ذلك ومع بــدء اســتعمال الفواصل الخفيفة وتطور استخدامها أصبح من السهل تطبيق نفس المبـــدأ فى انواع كثيرة من المبـــانى مثل المكتبـــات العامة ـ المتاحف ـ المستشـــفيات ... الخ من مبانى حتى المبانى السكنية واصبح الفراغ او المســطح هو الشىء المرغوب فقط وقد أدى ذلك الى خـروج معظم هذه الابنية من كونها فراغ مشـــكل ومكون من عناصر تظهر فى الخارج عما تمثله فى الداخـــل الى شـــكل عام مســـيطر (مبانى المخـازن) وبالتالى فمن غير الممكن ان تصبح مدننا فى الآخر عبارة عن كتل من الزجاج أو الحجارة ممسوخة المعانى ـ ولو ان ذلك تطور كبير فى التصـــميم المعمارى وتصنيع البناء .

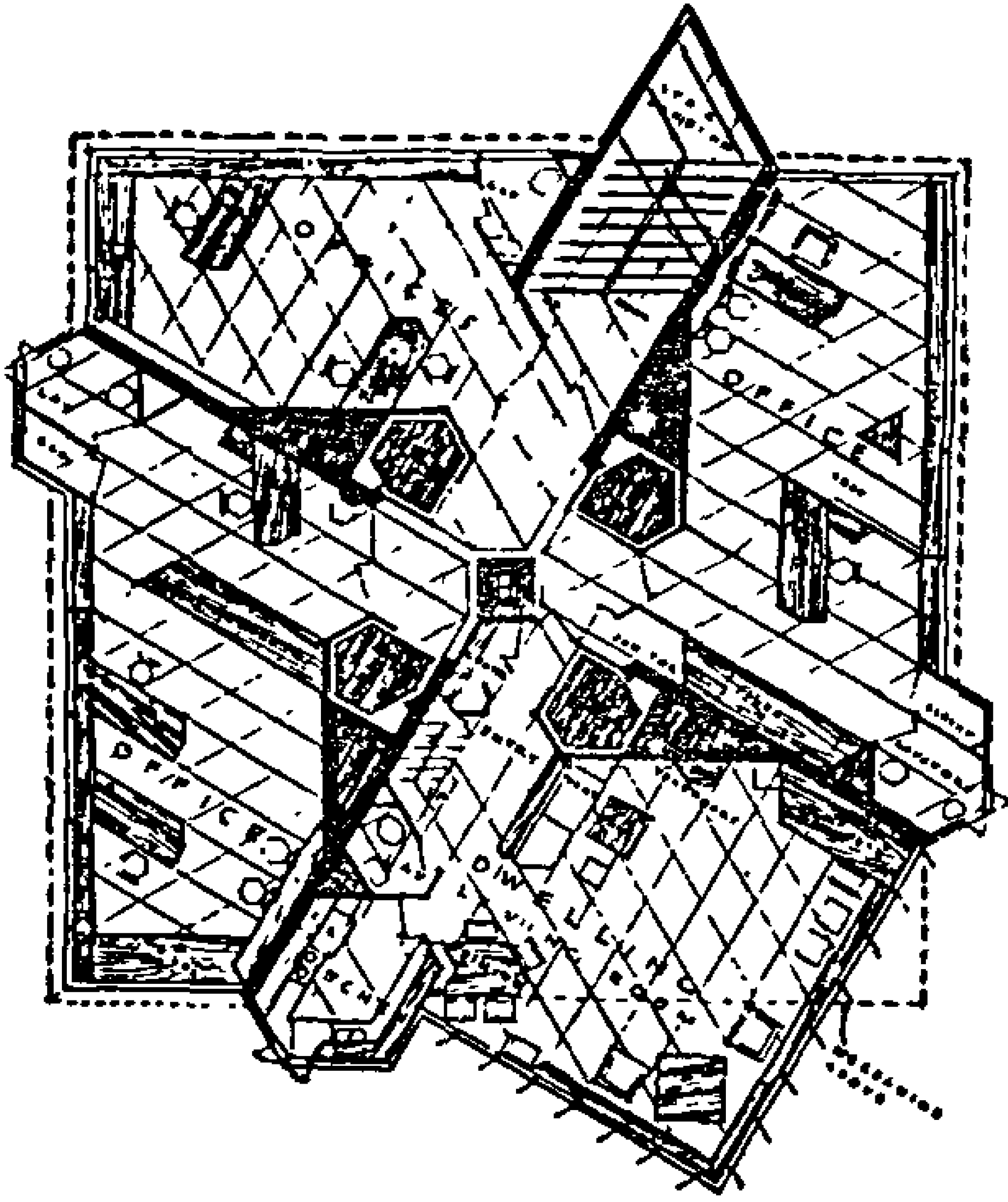
٥ ـ لم يتقبل المعماريين هذا التطور الخطير الذى سوف يتأثر به الشكل الخارجى ومن هنـا بدأ التحويل الى البحث عن القديم وتقليده أو تجريده وعمل برامج يتطلب فيها عناصر مميزة لاضفاء شكلية قديمه أو تقليـدية على المبنى أو تبسيط ذلك الى الرمزية ... وفى الحقيقه ان ذلك أدى الى مفترق طرق فاما أن تكون العمارة وظيفية فتظهر على شكل مخازن او جراجات أو يتم تشكيل للمبنى مخالف وبعيد عن نظـــريات العمارة يكـــون الاهتمام فيه بالجانب الشـكلى والذى يمكن ان يقبله العقل فى هذه الحالة اى أن تكون الواجهة الخارجيـــة ليست انعكاس كامل وحقيقى للداخل وذلك بالطبع ماعدا بعض المبانى التى تتطلب بحور كبيرة فى تصميمها مثـل (المبانى الرياضية والمطارات .... الخ) .

٦ ـ فى الواقع اننا نحترم نظـــريات العمارة كما نفخر بالمعماريين الرواد والمجددين من الاجيال التالية وانها (اى النظـــريات) تملأ وجداننـــا وعقولنا ولكن عند التصميم قد نختلف مؤقتا فى تفسير هذه النظريات او تطـورها وخصـــوصا بالنسبة لموضوع التشكيل الخارجى للمبانى . لأن الشكل يتأتى من محتوى مادى نفعى وظيفى وعاطفى وجمالى عندما تتفاعل هذه المكونات فى عقل الانسان وتتحول الى محتـــوى فكرى أو فلسفى تخرج بتفاعل عقلى مع المادة الخام فيولد الشكل الذى يصبح فيما بعد مادة حقيقية وقـد يساهم فى الانتاج أو توضع له مبادىء ـ جديدة تساهم مبادىء التشـــكيل فى تهذيبه كتكنيك تناسب الفكر المرتبط به او الفلسفة التى يعكسها فيخرج بعيدا عن مبادىء التشـــكيل المتعارف عليها غريبا فى أول الأمر مألوفا لأنه انطلق من فكر انسانى .

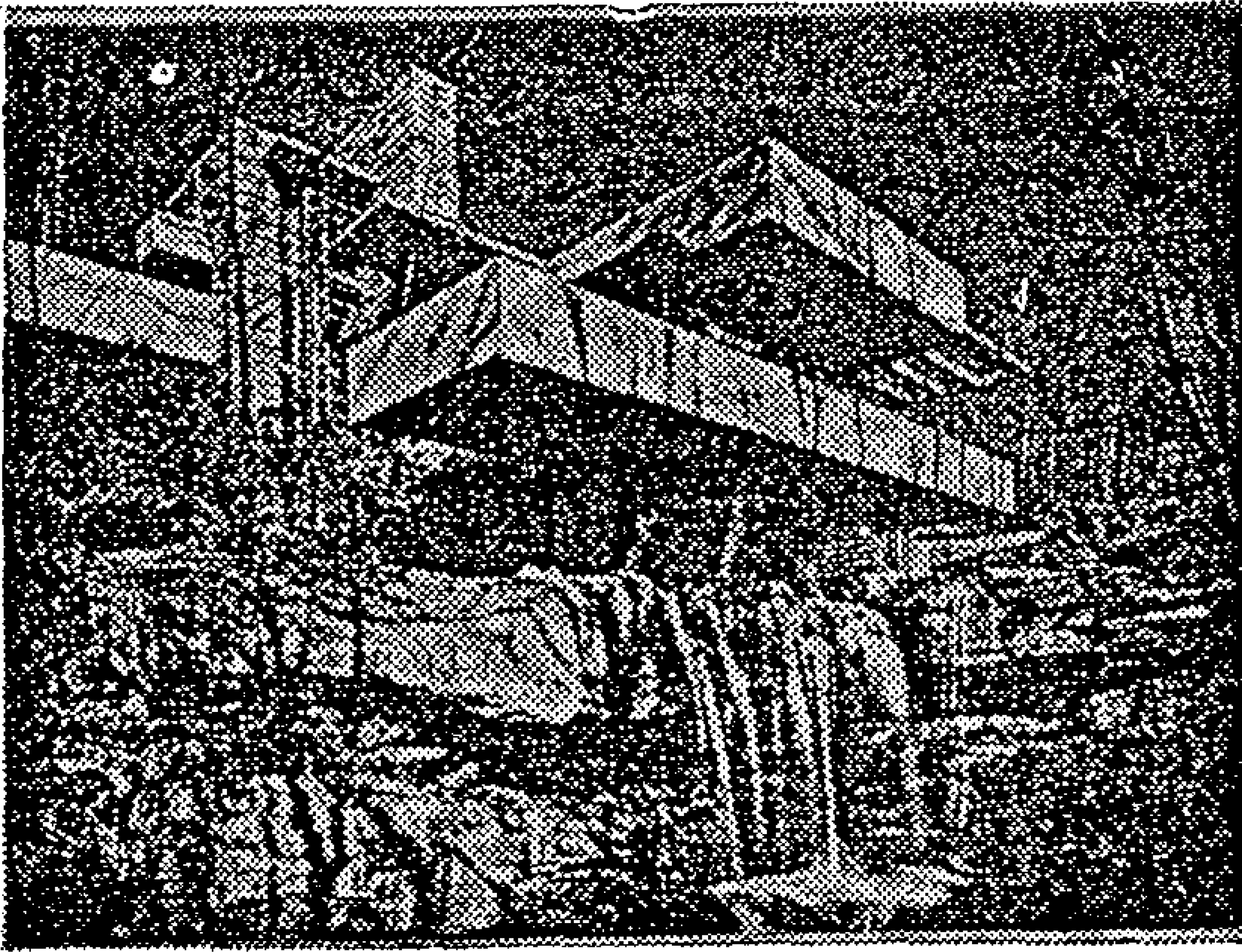
فالهـــدف النهائى للمعمارى ليس تطبيـــق النظريات الخاصة بالتصميم او بالتشـــكيل انما فهم جيد للحيـــاة وللعالم من حـــوله .. وانشاء مسطحات صالحة للاســـتعمال الجيد وانما الحياة الاجتماعية داخـــل هذا الفـراغ وخارجه وجعله بقـدر الامكان فراغ محبـــوب يمكـــن أن يرتاده الانســـان ، وكمـــا قـال (لوكورموزييه) « اذا كانت الكتلة ذات أشكال لم يفســـدها تنويعات غير مناســـبة واذا كان التوزيع له ايقاع واضـــح واذا كانت النســـب بين الفراغات والكتل مضبوطة تنقل العين الى المخ احساسات مترابطـــة وينال العقـــل رضى واستكفاء فهذه هى العمارة » .



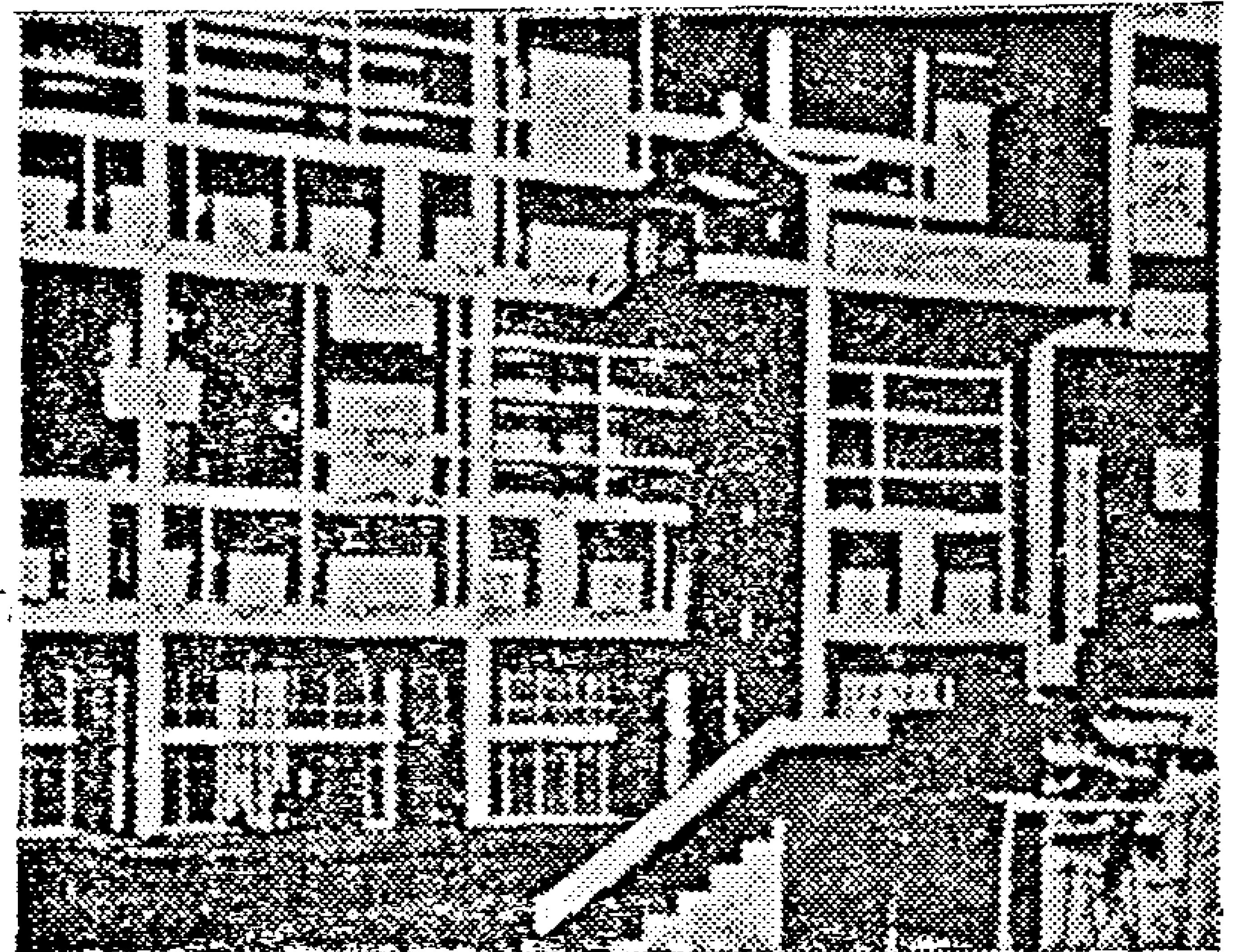
١ ــ مدخل بريس تاور تصميم المعمارى « فرنك لويد رايت » سنة ١٩٥٣ ــ تظهر كل التفاصيل حتى الاضاءة المثبتة بالسقف صممت لتعكس المديول المربع المتقاطع مع محاور الانشاء ــ



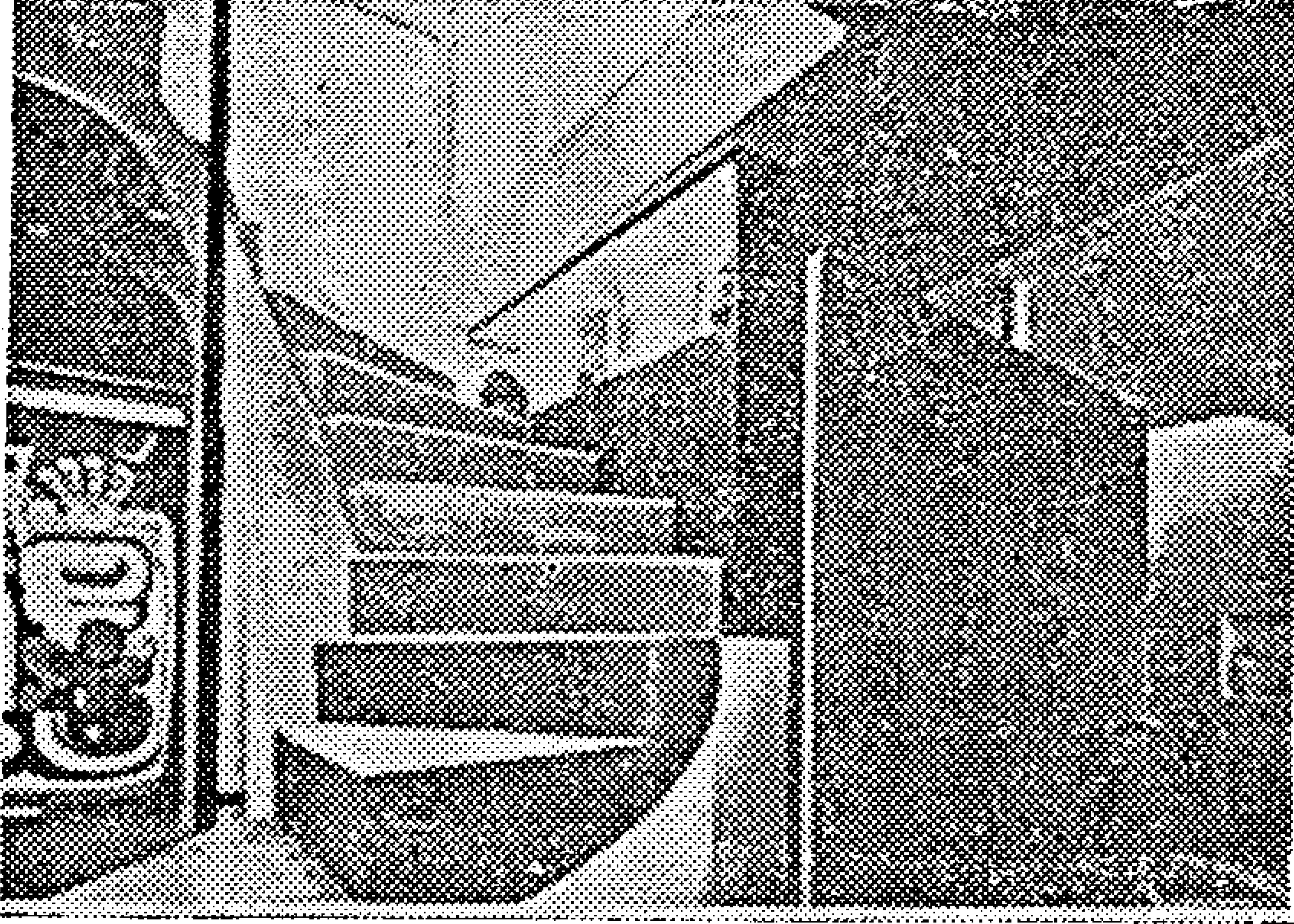
٢ ــ المسقط الافقى للدور المتكرر لمبنى (برايس تاور) يظهر تقاطع الاجزاء ــ الانشائية مع المربع وجميع الأدوار ــ تكون على هيئة (كوابيل) فكان هذا المنشأ سابق لعصره .



٣ ــ منزل (كوف مان) تصميم (فرنك لويد رايت) سنة ١٩٣٦ يظهر لانشائى للكوابيل الخارجية التكامل مع الطبيعة فوق شلال المياه ــ



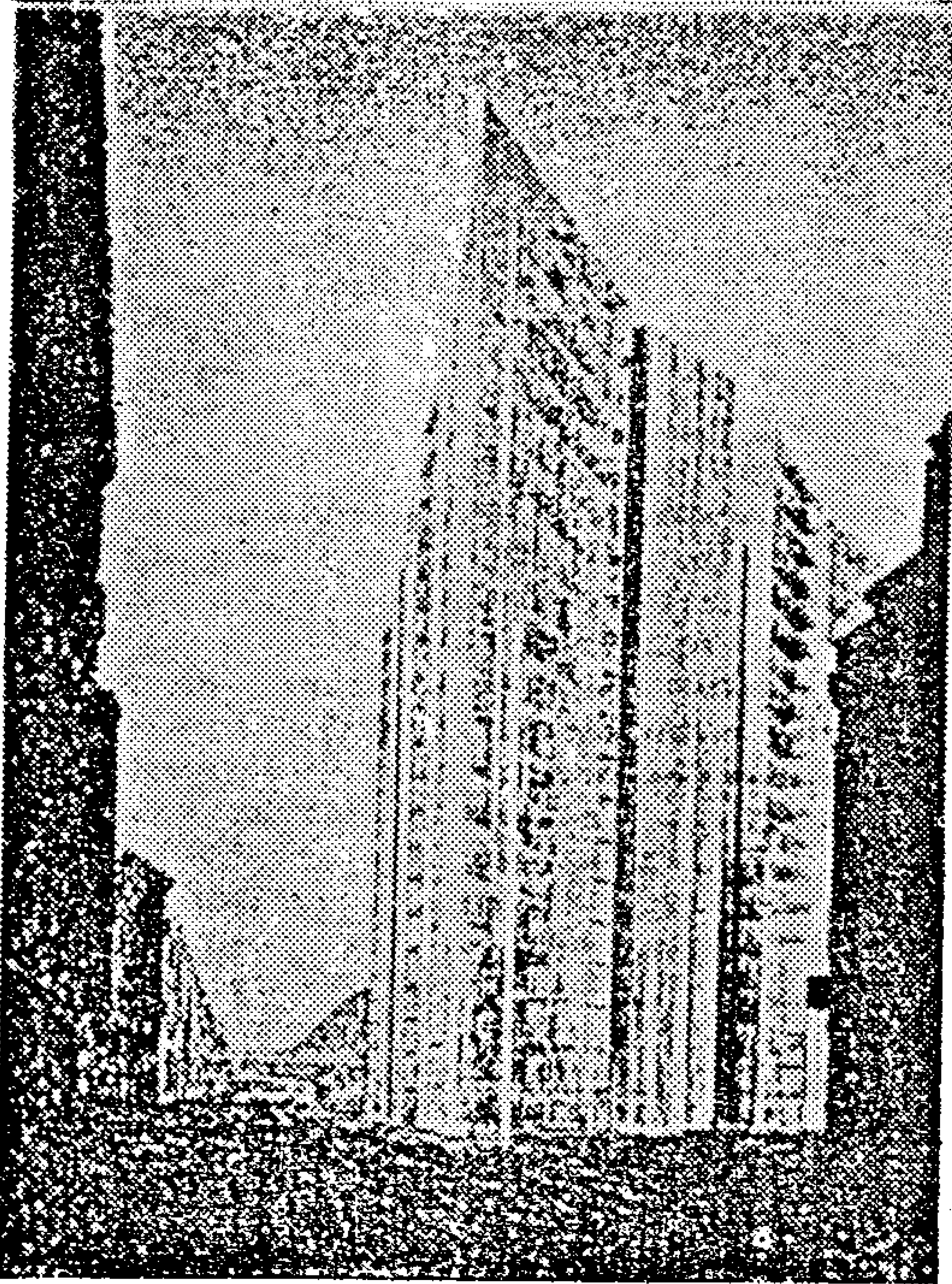
٤ ــ تفصلية واجهة مبنى السكرتارية العامة فى شاندجار بالهند تصميم المعمارى (لوكوربوزيه) وتظهر تشكيل البلكونات مع كاسرات الشمس الغير منتظمة فى تقسيمات متوافقة موضوعة بحسا ب ليكون التشكيل ملائم للمبنى فهى تخرج جميعها من المقياس الانسانى

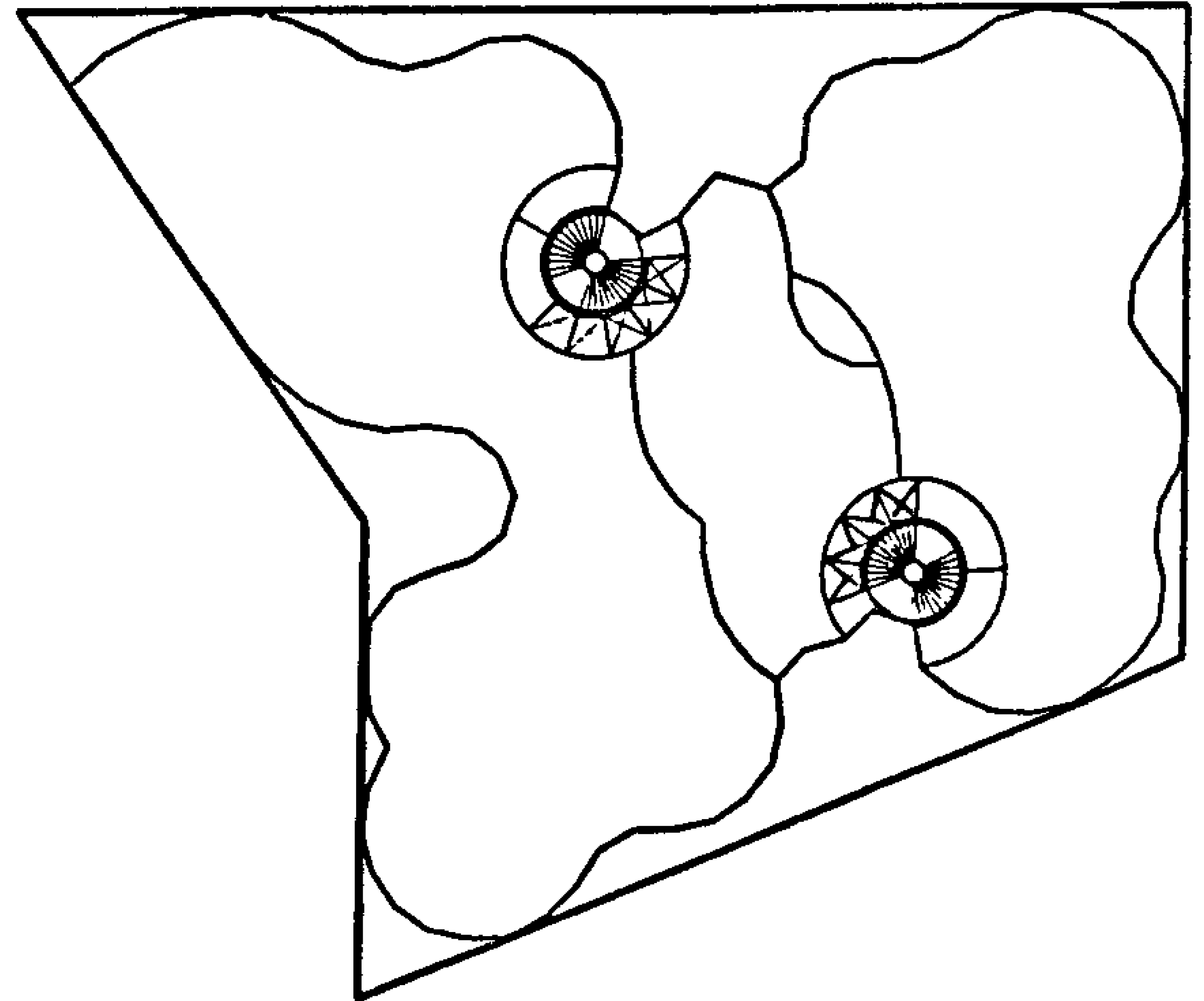


٥ ــ منظور عين الطائر لوحدتين أى بنائين من معرض (فايزنهوف) بالمانيا سنة ١٩٣٧ صممها (لوكوربوزييه) والأولى مثل فيلا (استروهان) التى صممها سنة ١٩٢٢ والثانية على اليمين عبارة عن مبنى سكنى مكون من شقق له أيضـا (روف جاردن) والتشكيل يعبر عن تصميمات هذا المعمارى المتميزة

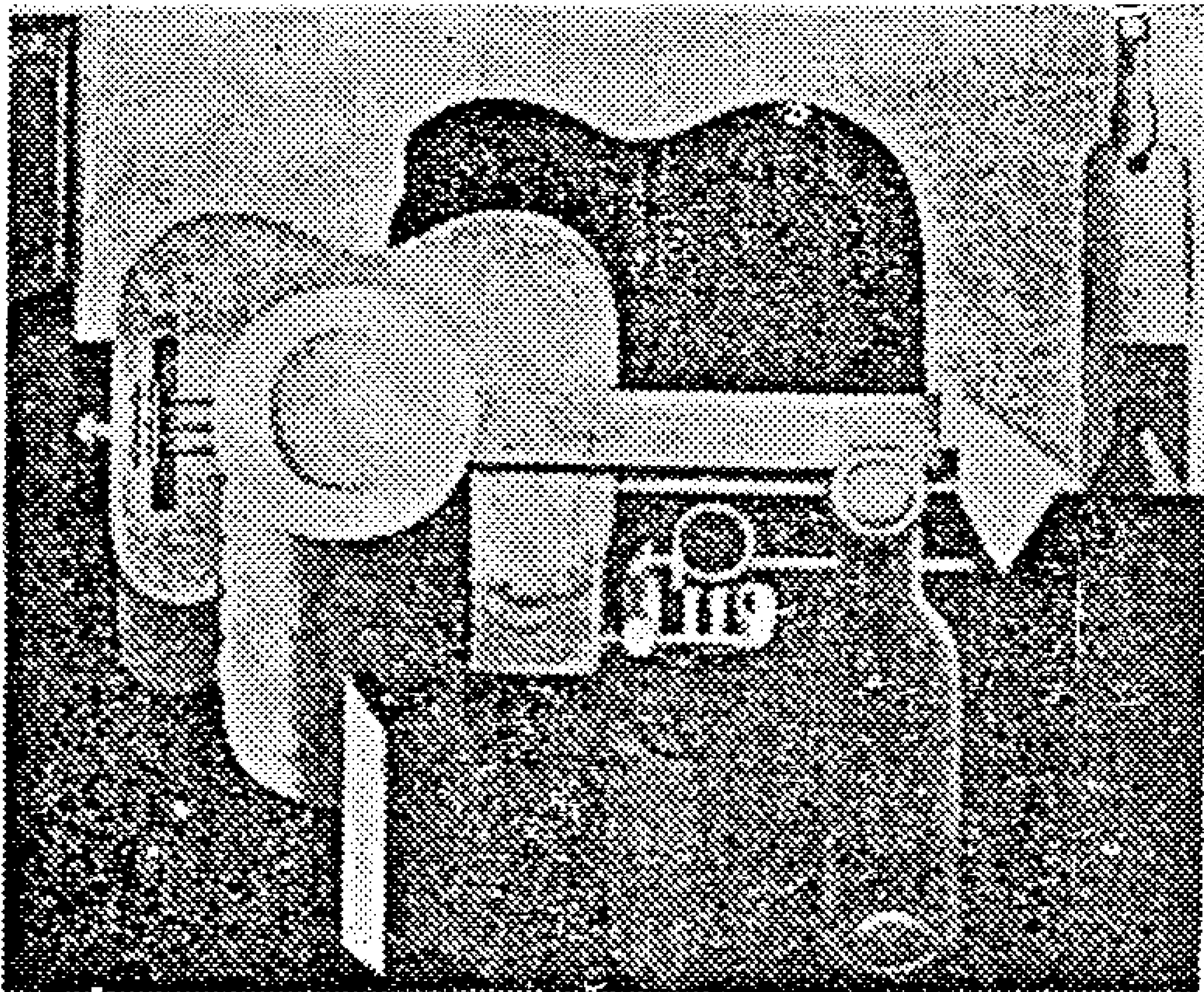
٦ ــ شقة المعمارى (لوكوربوزييه) الخاصة فى باريس سـنة ١٩٣٣ وهى مكونة من دورين (فيلا) والصورة توضح اهتمامه الزائد بتشكيل الفراغ .

٧ ــ ناطحة سـحاب زجاجية من تصـميم المعمارى (ميس فان دى روه) سنة ١٩١٤ وهى تعكس التشكيل الحر





٨ ــ مبنى ادارى من الزجاج صممه (ميس فان دى روة) سنة ١٩١٩



٩ ــ صورة رسـمها (لوكوربوزييه) سنة ١٩٢٠ من العناصر الهندسـية مثل تلك التى استعملها فى تصميم فيلا (سافوى) تظهر مدى ولعة بالتشكيل .

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(ب) الجزء الثانى ــ الطبعة الاولى ســـنة ١٩٦٦ القاهرة ــ « لوكوربوزيية » رائد العمارة تتبع الوظيفة .

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ــ « عمـــارة المســتقبل » ــ ص ٣٠ ، ٣١ د / محمد محمود عويضة

٣ ــ كتاب « شارع طه ــ وهمرسمث »

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فهرست الصـــور :

الصورة المنتقاة من المصادر الآتية :

المرجع الأول من المراجع الاجنبيـــة ــ المجلد الأول والثانى والثالث لرواد العمارة لكل الصور من رقم ١ الى رقم ٩ .

دراسة مقارنة لنصيب الفرد من الخدمات بالمدن الجديدة *

مهندس / محمد فتحى عارف **

كان الهدف من انشاء المدن الجديدة فى مصر هو استيعاب الزيادة السكانية من الوادى مع توفير المسكن المناسب والخدمة المناسبة . ولكن عند اعداد تقارير المدن الجديدة ظهر التفاوت الكبير بين المعدلات والمعايير التخطيطية للخدمات من حيث نصيب الفرد من الخدمة على كافة المستويات التخطيطية (المجاورة – الحى – القطاع – المدينة) وبالتالى تم اعداد مقارنة بين بعض المدن الجديدة (العاشر من رمضان – السادات – العامرية – ٦ أكتوبر – دمياط الجديدة – الأمل – بدر – العبور) للوقوف على مدى التفاوت الواضح بين المدن الجديدة لنصيب الفرد من كل خدمة حسب المستوى التخطيطى ونوع الخدمة ويقاس ذلك بنصيب الفرد من مساحة الموقع (م٢/ فرد) .

١ – الخدمات التعليمية : وتتمثل هذه الخدمة فى توفير مسطحات كافية للمبانى المدرسية والافنية بما يتناسب مع عدد تلاميذ المدرسة ويقاس ذلك بنصيب الطالب من مساحة الموقع (م٢/ الطالب) .

(أ) مدارس المرحلة الأولى : وتتوفر على مستوى المجاورة السكنية وهى تشمل مدارس التعليم الأساسى والابتدائى والاعدادى وكان نصيب الطالب من مساحة الموقع بالتعليم الابتدائى ٩ر١٤م٢/ طالب فى مدينة العاشر من رمضان بينما فى مدينة العامرية ٢ر١٠م٢/طالب وكذلك كان نصيب الطالب من مساحة الموقع بالتعليم الاعدادى ٥ر١٥م٢/ طالب فى مدينة العاشر من رمضان بينما فى مدينة العامرية ٨ر٢٣م٢/ طالب . اما باقى المدن الجديدة المقارنة فيتبع نظام التعليم الأساسى وكان أقل نصيب للطالب من مساحة الموقع ـر١١م٢/ طالب فى مدينة بدر ويصل الى ٤٠ر١٥م٢/ طالب فى مدينة السادات .

(ب) مدارس المرحلة الثانوية : ويتوفر على مستوى الحى والقطاع وهى تشمل مدارس الثانوية العامة والفنية (تجارى – صناعى – زراعى) ففى مدارس الثانوية العامة كان أقل نصيب للطالب من مساحة الموقع ٢ر١٣م٢/ طالب فى مدينة السادات بينما يصل الى ١ر٣١م٢/ طالب فى مدينة ٦ أكتوبر . والمدارس الثانوية التجارية لاتتوفر فى كافة المدن الجديدة المقارنة ، وكان أقل نصيب للطالب من مساحة الموقع ٢ر١٥م٢/ طالب فى مدينة السادات بينما تصل الى ضعف هذه المساحة٩ر٣٠م٢/ طالب فى مدينة العامرية. والمدارس الثانوية الصناعية تتوفر فى جميع المدن الجديدة المقارنة : وكان أقل نصيب الطالب من مساحة الموقع ٥ر١٦م٢/ طالب فى مدينة العاشر من رمضان . والمدارس الثانوية الزراعية لا تتوفر فى جميع المدن الجديدة المقارنة وكان اقل نصيب للطالب من مساحة الموقع ٥ر٢٤م٢/ طالب فى مدينة دمياط الجديدة بينما يصل الى ٧ر٨٤م٢/ طالب فى مدينة السادات . وفى مدينة ٦ أكتوبر وبدر لم تذكر مساحة محددة لموقع المدرسة الثانوية الزراعية .

٢ – الخدمات الصحية : وتتمثل هذه الخدمة فى توفير المنشآت والمؤسسات الصحية والعلاجية بمسطحات كافية تتناسب مع عدد السكان المخدومة . فيوجد نقط اسعاف تتوفر فى مدينتين فقط .. العاشر من رمضان ونصيب الفرد فيها من مساحة الموقع ٢٠ر٠م٢/فرد ومدينة العبور ويبلغ فيها ١٥ر٠م٢/ فرد . والمراكز الصحية لرعاية الاومومة والطفولة تتوفر فى جميع المدن الجديدة المقارنة وكان أقل نصيب للفرد من مساحة الموقع ٢٠ر٠م٢/ فرد فى مدينة العاشر من رمضان بينما يصل الى ٨ر٠م٢/فرد فى مدينة ٦ أكتوبر . والمستشفى الصغير تتوفر فى مدينتين فقط العاشر من رمضان ونصيب الفرد فيها من مساحة الموقع ١٨ر٠م٢/ فرد ومدينة دمياط الجديدة ويبلغ فيها ١٤ر٠م٢/ فرد . والعيادات الشاملة والوحدات الصحية تتوفر فى اربع مدن فقط من المدن الجديدة المقارنة وكن اقل نصيب للفرد من مساحة الموقع ٢٨ر٠م٢/ فرد فى مدينة العامرية بينما يصل الى ٤ر٠م٢/ فرد فى مدينة العاشر من رمضان. والمراكز الصحية والعيادات

(*) تحت اشراف ا.د. احمد خالد علام ا.د. اسماعيل عامر .

(**) مساعد باحث بمركز بحوث البناء .

مَقارَنة الخَدَمات التَعليمية بالمُدن الجَديدة

مدارس المرحلة الأولى

جدول رقم ١

وجه المقارنة	العاشر من رمضان		السادات	العامرية		٦ اكتوبر	دمياط الجديدة	الأمل	بدر	العبور
	إبتدائي	إعدادي	* تعليم أساسي	إبتدائي	إعدادي	تعليم أساسي	تعليم أساسي	تعليم أساسي	تعليم أساسي	تعليم أساسي
مساحة الموقع (م٢).	١٠٠٠٠	١٣٠٠٠	١٤٦٠٠	٨٥٠٠	٢٠٠٠	١٥٧٥٠	١٢٣٢٠	٢٣١٠٠	٢١٤٢٠	٨٠٠٠
المساحة المبنية (م٢).	٤٢٠٠	٦٠٠٠	٢٢٧٠	٢٠٠٠	٣٠٠٠	٣٥٠٠	٦٤٠٠	٥٠٠٠		
عدد السكان المخدومة (نسمة).	٤٤٠٠	١٦٧٠٠	٥٠٠٠	٥٥٠٠	١١٠٠٠	٥٠٠٠	٩٠٠٠	١٠٠٠٠	١١٠٠٠	٣٨٧٠
نصيب الفرد من مساحة الموقع (م٢/فرد)	٢,٨٧	٠,٧٨	٢,٩٢	١,٥٤	٠,١٨٢	٣,١٥	١,٤	٢,٣١	١,٩	٢,٠
نصيب الفرد من المساحة المبنية (م٢/فرد)	٠,٩٥	٠,٣٦	٠,٤٥	٠,٣٦	٠,٢٧	٠,٧	٠,٧	٠,٥		
نصيب الطالب من مساحة الموقع (م٢/طالب)	١١,٩	١٥,٥	١٥,٤٠	١٠,٢	٢,٣٨	١٢,٥	١٣,٤	١٤,٠	١١,٠	١٢,٧
نصيب الطالب من المساحة المبنية (م٢/طالب)	٥,٠	٧,١	٢,٤	٢,٤	٣,٥٧	٢,٧٨	٧,٠	٣,٠		
عدد الفصول بالمدرسة (فصل).	٢٤	٢٤	٢٧	٢٤	٢٤	٣٦	٢٧	٤١	٤٨	١٨
عدد التلاميذ بالفصل (تلميذ).	٣٥	٣٥	٣٥	٣٥	٣٥	٣٥	٣٤	٤٠	٤٠	٣٥
عدد التلاميذ بالمدرسة (تلميذ).	٨٤٠	٨٤٠	٩٤٥	٨٤٠	٨٤٠	١٢٦٠	٩١٨	١٦٤٠	١٩٤٧	٦٣٠

* من واقع الرسومات التفصيلية لأحد مجاورات مدينة السادات.

جدول رقم (١)

المدرسة الثانوية العامة

جدول رقم ٢

وجه المقارنة	العاشر من رمضان	السادات	العامرية	٦ اكتوبر	دمياط الجديدة	الأمل	بدر	العبور
مساحة الموقع (م٢).	١٦٠٠٠	١١٩٠٠	٢٥٠٠٠	٢٥٢٠٠	١٨٥٩٥	٢٥٢٠٠	٢٥٢٠٠	١٦٠٠٠
المساحة المبنية (م٢).	٤٥٠٠	٥٥٠٠	٥٠٠٠	٤٤٠٠	١١٤٣٢	٥٠٠٠		
عدد السكان المخدومة (نسمة).	٣٧,٥٠٠	٣,٠٠٠	٥٠,٠٠٠	٢٧,٥٠٠	٥٤,٠٠٠	٤٠,٠٠٠	٤٧,٥٠٠	٣٠,٠٠٠
نصيب الفرد من مساحة الموقع (م٢/فرد)	٠,٤٢	٠,٤	٠,٥	٠,٩٢	٠,٣٤	٠,٦	٠,٥٣	٠,٥٣
نصيب الفرد من المساحة المبنية (م٢/فرد)	٠,١٢	٠,١٨	٠,١	٠,١٦	٠,٢١	٠,١		
نصيب الطالب من مساحة الموقع (م٢/طالب)	٢٢,٢	١٣,٢	٣٠,٩	٣١,١	٢١,٥	٢٠,٠	٢١,٠	٢٢,٢
نصيب الطالب من المساحة المبنية (م٢/طالب)	٦,٢٥	٦,١	٦,٢	٥,٤	١٣,٢	٤,٠		
عدد الفصول بالمدرسة (فصل).	٢٤	٣٠	٢٧	٢٧	٢٤	٣٦	٤٠	٢٤
عدد التلاميذ بالفصل (تلميذ).	٣٠	٣٠	٣٠	٣٠	٣٦	٣٥	٣٠	٣٠
عدد التلاميذ بالمدرسة (تلميذ).	٧٢٠	٩٠٠	٨١٠	٨١٠	٨٦٤	١٢٦٠	١٢٠٠	٧٢٠

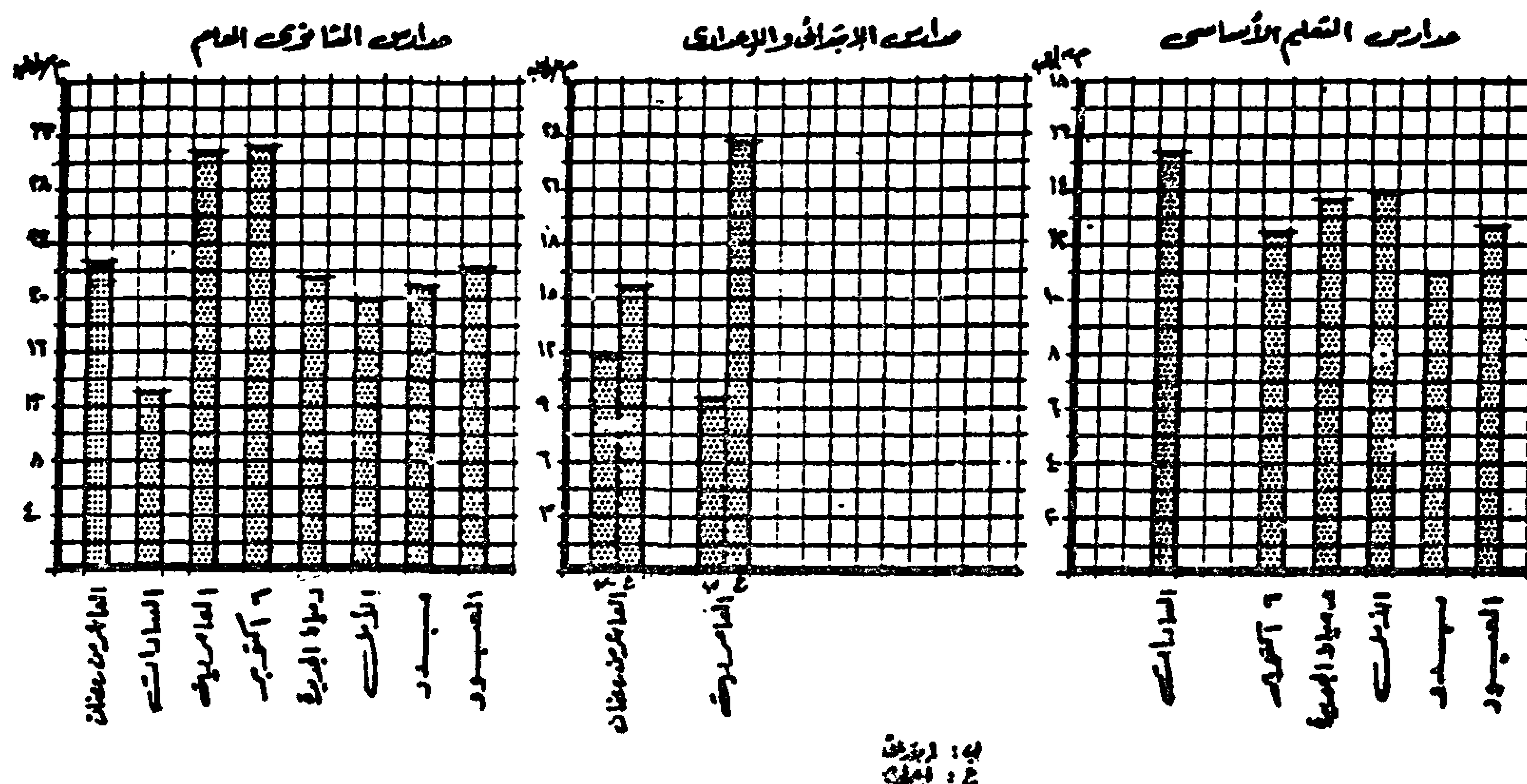
جدول رقم (٢)

مدارس التعليم الثانوي الفني

جدول رقم ٣

وجه المقارنة	العاشر من رمضان		السادات			العامرية			٦ اكتوبر		دمياط الجديدة			الأمل			بدر			العبور
	تجاري	صناعي	تجاري	فني	زراعي	فني	زراعي	تجاري	زراعي	صناعي	تجاري	فني	زراعي	تجاري	فني	زراعي	تجاري	فني	زراعي	صناعي
مساحة الموقع (م٢).	١٨٠٠٠	١٦٠٠٠	١١٤٠٠	٢٤٢٠٠	٥٢٦٠٠	٢٥٠٠٠	٤٠٠٠٠	٢٥٠٠٠	٣٣٦٠٠	٢٥٢٠٠	١٥٣٣٧	٣٢٣٤٠	١٨٨٢٨	٢٩٤٠٠			٢٥٢٠٠ - ٣٧٨٠٠			٢٤٠٠٠
المساحة المبنية (م٢)	١٠٥٠٠	٨٠٠٠	٥٠٠٠	١٣٠٠٠	٩٥٠٠	٧٠٠٠	٥٠٠٠	٥٠٠٠	٦٠٠٠	٥٠٠٠	٩٩٢٠	٢١٠٠٠	٩٣٣٦	٦٥٠٠			[illegible]			
عدد السكان المخدومة (نسمة).	٣٧٥٠٠		٩٠٠٠٠	٢٥٠٠٠	٥٠٠٠٠	٥٠٠٠٠			٢٧٥٠٠		٥٤٠٠٠		٣٢٠٠٠	٤٠٠٠٠			٤٧٥٠٠			٢٤٠٠٠٠
نصيب الفرد من مساحة الموقع (م٢/فرد).	٠,٤٨	٠,٤٣	٠,١٣	٠,٠٩	٠,١١	٠,٥	٠,٨	٠,٥	١,٢٢	٠,٩٢	٠,٣	٠,٦	٠,٠٧	٠,٧			٠,٨			٠,١
نصيب الفرد من المساحة المبنية (م٢/فرد).	٠,٢٨	٠,٢١	٠,٠٥	٠,٠٥	٠,٠١٩	٠,١٤	٠,١	٠,١	٠,٢٢	٠,٢	٠,١	٠,٣	٠,٢	٠,٢						
نصيب الطالب من مساحة الموقع (م٢/الطالب)	٢٥,٠	٤٠,٤	١٥,٢	١٦,٥	٨٤,٧	٣٠,٩	٤٩,٤	٣٠,٩	[illegible]	٢٤,٧	١٩,٠	٢٢,٤	٢٤,٥	٢٧,٠			٣٠-٢٠			٣٢
نصيب الطالب من المساحة المبنية (م٢/الطالب)	١٤,٦	٢٠,٢	٦,٦	٨,٨	١٤,٠	٨,٦٤	٦,١٧	٦,٣٧		٥,٠	١٦,٢	١٤,٥	١٢,١	٦,٠						
عدد الفصول بالمدرسة (فصل).	٢٤	١٢	٢٥	٤٩	٢٣	٢٧	٢٧	٢٧		٣٤	٢٧	٣٦	٢٤	٣٢,٠			٣٦			٣٠
عدد التلاميذ بالفصل (تلميذ).	٣	٣٣	٣٠	٣٠	٣٠	٣٠	٣٠	٣٠		٣٠	٣٠	٤٠	٣٢	٣٤,٠			٣٥			٢٥
عدد التلاميذ بالمدرسة (تلميذ).	٧٢٠	٣٩٦	٧٥٠	١٤٧٠	٦٨٠	٨١٠	٨١٠	٨١٠		١٠٢٠	٨١٠	١٤٤٠	٧٦٧	١٠٨٨			١٢٦٠			٧٥٠

جدول رقم (٣)



شكل رقم (١)

التخصصية تتوفر في خمس مدن فقط من المدن الجديدة المقارنة وكان أقل نصيب للفرد من مساحة الموقع ١٢.٠رم٢/ فرد في مدينة العاشر من رمضان بينما يصل الى ٥.٠رم٢/ فرد في مدينة الامل . والمستشفى العام تتوفر في جميع المدن الجديدة المقارنة وكان أقل نصيب للفرد من مساحة الموقع ٥٤.٠رم٢/ فرد في مدينة السادات بينما يصل الى ١٦ارم٢/ فرد في مدينتي العامرية ودمياط الجديدة. والمستشفى المركزي التخصصي تتوفر في سبع مدن من المدن الجديدة المقارنة وكان أقل نصيب للفرد من مساحة الموقع ٠٧.٠رم٢/ فرد في مدينتي العامرية و٦ أكتوبر بينما يصل الى ١٢ارم٢/ فرد في مدينة السادات . والمركز العلاجي والطوارىء والتأمين الصحي تتوفر في أربع مدن فقط من المدن الجديدة المقارنة وكان أقل نصيب للفرد من مساحة الموقع ٠٠٢.٠رم٢/ فرد في مدينة السادات ويصل الى ارم٢/ فرد في مدينة العامرية .

مقارنة الخدمات الصحية بالمدن الجديدة

جدول رقم ( )

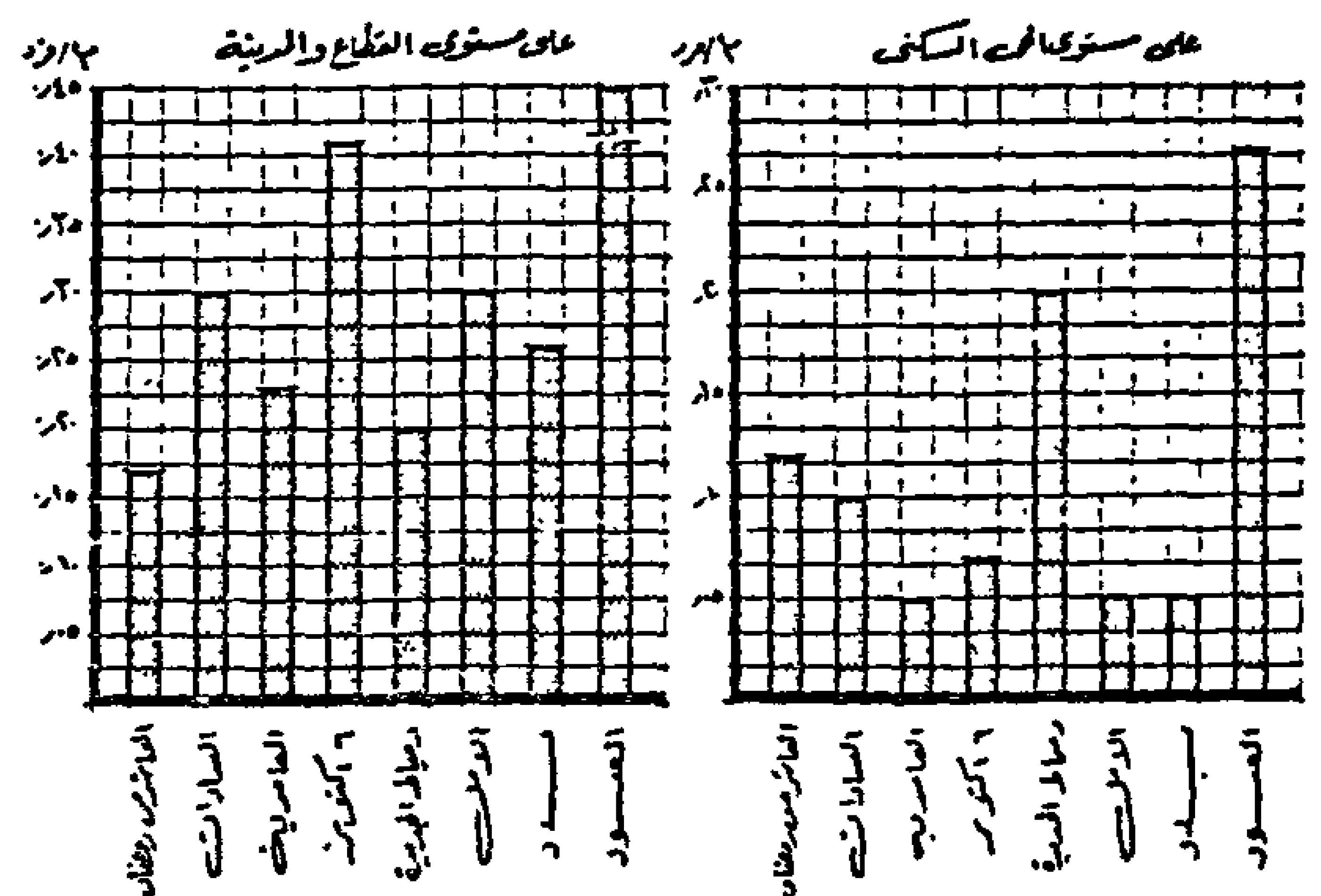
منشآت الخدمة	العاشر من رمضان ٥	٤	٣	٢	١	السادات ٥	٤	٣	٢	١	العامرية ٥	٤	٣	٢	١	٦ أكتوبر ٥	٤	٣	٢	١
نقط إسعاف	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]															
مراكز صحية لرعاية الأمومة والطفولة	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
مستشفى صغير	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]															
عيادات بشاملة ووحدة صحية	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					
مراكز صحية وعيادات تخصصية	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
مستشفى عام	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
مستشفى مركزي وتخصصي	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
مركز علاجي وطوارئ وتأمين صحي	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					

منشآت الخدمة	دمياط الجديدة ٥	٤	٣	٢	١	الأمل ٥	٤	٣	٢	١	بدر ٥	٤	٣	٢	١	الصبور ٥	٤	٣	٢	١
نقط إسعاف																	[illegible]	[illegible]		[illegible]
مراكز صحية لرعاية الأمومة والطفولة	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]		[illegible]	[illegible]		[illegible]
مستشفى صغير	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]															
عيادات بشاملة ووحدة صحية																	[illegible]	[illegible]		[illegible]
مراكز صحية وعيادات تخصصية	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]										
مستشفى عام	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]		[illegible]	[illegible]		[illegible]
مستشفى مركزي وتخصصي																				
مركز علاجي وطوارئ وتأمين صحي	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]															

١- مساحة الموقع (م٢) .
٢- المساحة المبنية (م٢) .
٣- عدد السكان المخدومة (نسمة) .
ـه نصيب الفرد من مساحة الموقع (م٢/ فرد) .
ـب نصيب الفرد من المساحة المبنية (م٢/ فرد) .

جدول رقم (٤)

٣ ـ **الخدمات التجارية :** وتتمثل هذه الخدمة فى توفير المحـــلات التجـارية وما تحتاجه من مسطحات أخـــرى وهى تتوفـــر على جميع مستويات المدينة ابتداء من مستوى المجـاورة وتنتهى على مستوى المدينة . فعلى مســـتوى المجاورة السكنية كان أقـل نصيب للفـرد من مساحة الموقع ١٨ر٢م/ فرد فى مدينة العبـور بينما يصل الى ٩٦ر٢م/ فرد فى مدينة الامل . وعلى مستوى الحى كان أقـل نصيب للفرد من مساحة الموقع ٠٣ر٢م/ فرد بينما يصـل الى ٩٢ر٢م/ فرد فى مدينة ٦ أكتوبر . وعلى مستوى القطاع السكنى والمدينة كان أقل نصيب للفرد من مساحة الموقع ٠٤ر٢م/ فى مدينة العبور بينما يصـــل الى ٩٢ر٢م/ فـــرد فى مدينة دمياط الجديدة .



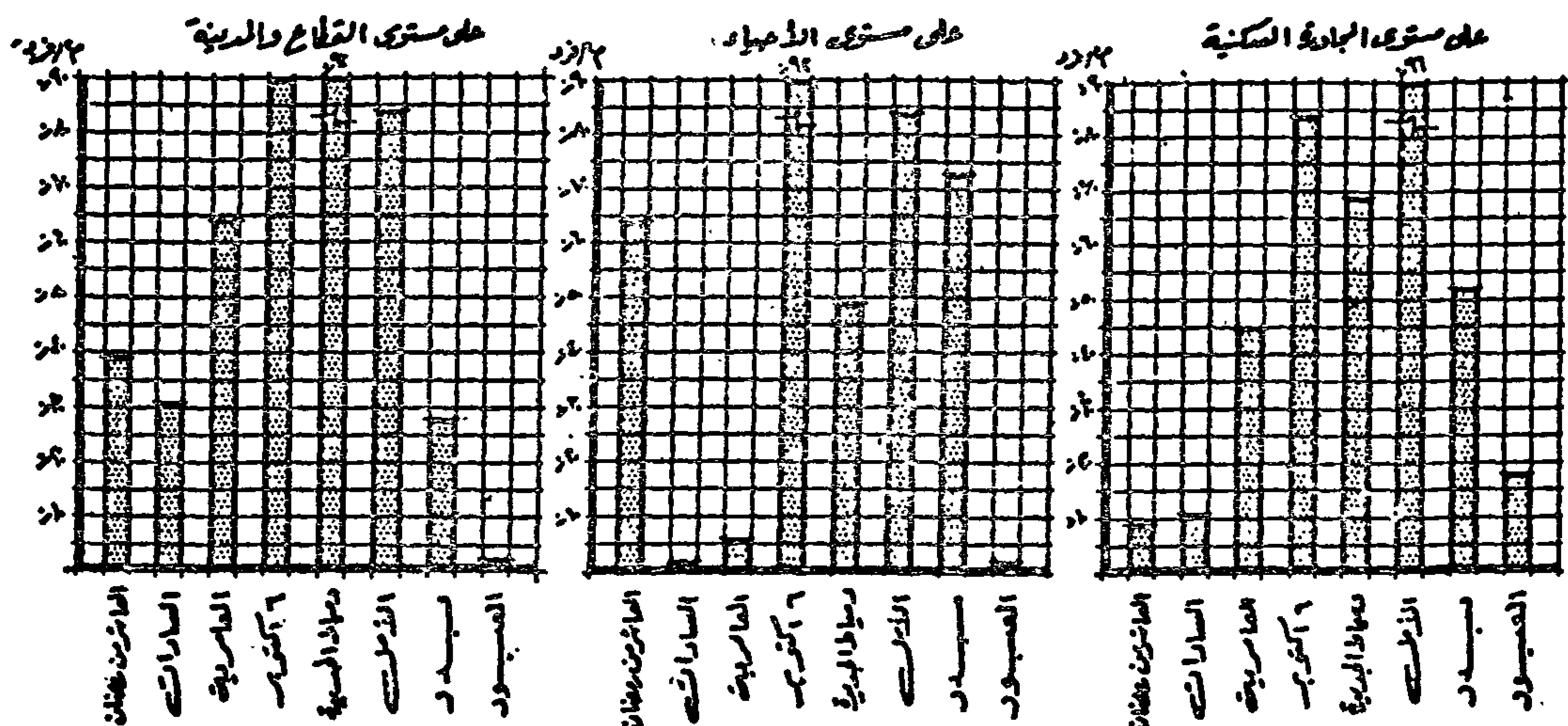
شكل رقم (٢)

مقارنة التدرج الهرمى للخدمات التجارية بالمدن الجديدة

الخدمات التجارية — جدول رقم : ٥

مستوى الخدمة	وجه المقارنة	العاشر من رمضان	السادات	العامرية	٦ أكتوبر	دمياط الجديدة	الامل	بدر	العبور
المجاورة السكنية	مساحة الموقع (م٢) .	٤٠٠٠	٥٦٠	٥٠٠ لكل مجاورتين	٤٢٠٠	٦١٧٠	٤٨٠٠	٥٨٨٠	١٨٠٠
	المساحة المبنية (م٢) .	٢٧٠٠	٥٦٠	٢٠٠٠	٢١٢٠	٤٢١٨	٢٠٤٠	٢٩٤٠	
	عدد السكان المخدومة (نسمة) .	٤٤٠٠	٥٠٠	١١٠٠٠	٥٠٠٠	٩٠٠٠	٥٠٠٠	١١٢٥٠	١٠٠٠٠
	نصيب الفرد من مساحة الموقع (م٢/فرد) .	٠,٩	٠,١١	٠,٤٥	٠,٨٤	٠,٦٩	٠,٩٦	٠,٥٢	٠,١٨
	نصيب الفرد من المساحة المبنية (م٢/فرد) .	٠,٦	٠,١١	٠,١٨	٠,٤٣	٠,٤٦	٠,٤	٠,٢٦	
الحى السكنى	مساحة الموقع (م٢) .	٢٤٠٠٠	١٠١٣	٣٠٠٠٠	٢٥٢٠٠	٢٦٤٠٠	٣٣٦٠٠	٣٤٨٦٠	٢٥٠٠
	المساحة المبنية (م٢) .	١٤٩٠٠	١٠١٣	١٦٠٠٠	٥٠٠٠	١٨٠٠٠	١٤٢٨٠	١٧٤٣٠	
	عدد السكان المخدومة (نسمة) .	٣٧٥٠٠	٣٠٠٠٠	٥٠٠٠٠	٢٧٥٠٠	٥٤٠٠٠	٤٠٠٠٠	٤٧٥٠٠	٤٠٠٠٠
	نصيب الفرد من مساحة الموقع (م٢/فرد) .	٠,٦٤	٠,٠٣	٠,٦	٠,٩٣	٠,٤٩	٠,٨٤	٠,٧٣	٠,٠٦
	نصيب الفرد من المساحة المبنية (م٢/فرد) .	٠,٤	٠,٠٢	٠,٣٢	٠,٢٠	٠,٣٣	٠,٣٥	٠,٣٧	
القطاع السكنى أو المدينة	مساحة الموقع (م٢) .	١٩٤٠٠٠	١٥٦٢٧٥	٢٢٠٠٠٠	٣١٥٠٠٠	٢٤٨٤٩٠	٢١٠٠٠٠	٧٠١٤٠	١١٣٠٠
	المساحة المبنية (م٢) .	١٢٦٨٠٠	٢١٨٩٠٠	٢٢٥٠٠٠	١٧٥٠٠٠	٢٢٥٩٠	٨٩٢٥٠	٣٥٠٧٠	
	عدد السكان المخدومة (نسمة) .	٥٠٠٠٠٠	٥٠٠٠٠٠	٥٠٠٠٠٠	٣٥٠٠٠٠	٢٧٠٠٠٠	٢٥٠٠٠٠	٢٥٠٠٠٠	٢٤٠٠٠٠
	نصيب الفرد من مساحة الموقع (م٢/فرد) .	٠,٣٩	٠,٣١	٠,٦٤	٠,٩	٠,٩٢	٠,٨٤	٠,٢٨	٠,٠٤
	نصيب الفرد من المساحة المبنية (م٢/فرد) .	٠,٢٥	٠,٤٣	٠,٤٥	٠,٥	٠,٨٣	٠,٣٥	٠,١٤	

جدول رقم (٥)



شكل رقم (٣)

٤ ـ **الخدمات الدينية :** وهي تتمثل فى توفير المساحات والمسطحات الكافية لمباني المساجد والمساحات الفضاء التي حولها وكذلك مباني الكنائس وذلك بما يتناسب مع عدد السكان المخدومة وعلى مستوى المجاورة السكنية تتوفر المساجد فى جميع المدن الجديدة المقارنة وكان أقل نصيب للفرد من مساحة الموقع ٠,١٦م٢/ فرد فى مدينة العبور بينما يصل الى ٠,٤٢م٢/ فرد فى مدينة الامل . وعلى مستوى الحى السكني تتوفر المساجد وكان أقل نصيب للفرد من مساحة الموقع ٠,٠٥م٢/ فرد فى مدينة السادات بينما يصل الى ٠,٢٣م٢/ فرد فى مدينة ٦ اكتوبر . والكنائس تتوفر فى ست مدن فقط من المدن الجديدة المقارنة وكان أقل نصيب للفرد من مساحة الموقع ٠,١٣م٢/ فرد فى مدينة السادات بينما يصل الى ٠,١م٢/ فرد فى ثلاث مدن ٦ اكتوبر والأمل وبدر . وعلى مستوى القطاع السكني والمدينة تتوفر المساجد والكنائس فكان أقل نصيب للفرد ٠,٠٢م٢/ فرد فى مدينة العامرية من مساحة الموقع للمسجد بينما يصل الى ٠,٠٨م٢/ فرد فى مدينتى الأمل والعبور وكان أقل نصيب للفرد من مساحة الموقع للكنائس ٠,٠١٤م٢/ فرد فى مدينة دمياط الجديدة بينما يصل الى ٠,٠٤٢م٢/ فى مدينة الامل

مقارنة التدرج الهرمي للخدمات الدينية بالمدن الجديدة

المساجد — جدول رقم (٦)

مستوى الخدمة	وجه المقارنة	العاشر من رمضان	السادات	العامرية	٦ اكتوبر	دمياط الجديدة	الأمل	بدر	العبور
المجاورة السكنية	مساحة الموقع (م٢)	١٥٠٠	١٠٠٠	٢٠٠٠ [illegible]	١٤٧٠	٣٣٠٠	٢١٠٠	٢٩٤٠	٥٠٠
	المساحة المبنية (م٢)	١٠٠	٥٠٠	٨٠٠	٦٦٠	٢٨٠٠	١٢٥٠	١٩١٠	٣٠٠
	عدد السكان المخدومة (نسمة)	٤٤٠٠	٥٠٠٠	١١٠٠٠	٥٠٠٠	٩٠٠٠	٥٠٠٠	١١٢٥٠	٣٠٠٠
	نصيب الفرد من مساحة الموقع (م٢/فرد)	٠,٣٤	٠,٣	٠,١٨	٠,٣٠	٠,٣٧	٠,٤٢	٠,٣	٠,١٦
	نصيب الفرد من المساحة المبنية (م٢/فرد)	٠,٢٢	٠,١	٠,٠٧	٠,١٢	٠,٣	٠,٢٨	٠,١٦	٠,١٠
الحى السكنى	مساحة الموقع (م٢)	٣٦٠٠	٤٩٠٠	٤٠٠٠	٦٣٠٠	٤٩٥٠	٥٢٥٠	٦٣٠٠	٣٠٠٠
	المساحة المبنية (م٢)	٢٤٠٠	١٩٠٠	٢٢٠٠	١٧٥٠	٣٠٠٠	١٧٥٠	٤٢٠٠	٢٠٠٠
	عدد السكان المخدومة (نسمة)	٣٧٥٠٠	٩٠٠٠٠	٥٠٠٠٠	٢٧٥٠٠	٥٤٠٠٠	٤٠٠٠٠	٤٧٥٠٠	٤٠٠٠٠
	نصيب الفرد من مساحة الموقع (م٢/فرد)	٠,٠٩	٠,٠٥	٠,٠٨	٠,٢٣	٠,٠٩	٠,١٣	٠,١٣	٠,٧٥
	نصيب الفرد من المساحة المبنية (م٢/فرد)	٠,٠٦	٠,٠٢	٠,٠٤	٠,٠٦	٠,٠٦	٠,٠٤	٠,٠٩	٠,٠٥
القطاع السكنى والمدينة	مساحة الموقع (م٢)	١٠٥٠٠	١٨٠٠٠	١٥٠٠٠	٨٤٠٠	١١٤٢٥	٢٨٩٠٠	١٥١٢٠	٢٠٠٠٠
	المساحة المبنية (م٢)	٥٠٠٠	٦٥٠٠	٦٦٦٦	٤٥٠٠	٨٦٥٠	١٣٦٠٠	٢٠٠٨٠	١٣٠٠٠
	عدد السكان المخدومة (نسمة)	٢٥٠٠٠٠	٥٠٠٠٠٠	٥٠٠٠٠٠	٣٥٠٠٠٠	٢٧٠٠٠٠	٢٥٠٠٠٠	٣٥٠٠٠٠	٢٤٠٠٠٠
	نصيب الفرد من مساحة الموقع (م٢/فرد)	٠,٠٤	٠,٠٣	٠,٠٢	٠,٠٧	٠,٠٤	٠,٠٨	٠,٠٦	٠,٠٨
	نصيب الفرد من المساحة المبنية (م٢/فرد)	[illegible]	٠,٠١	٠,٠١	٠,٠٢	٠,٠٣	٠,٠٥	٠,٠٤	٠,٠٥

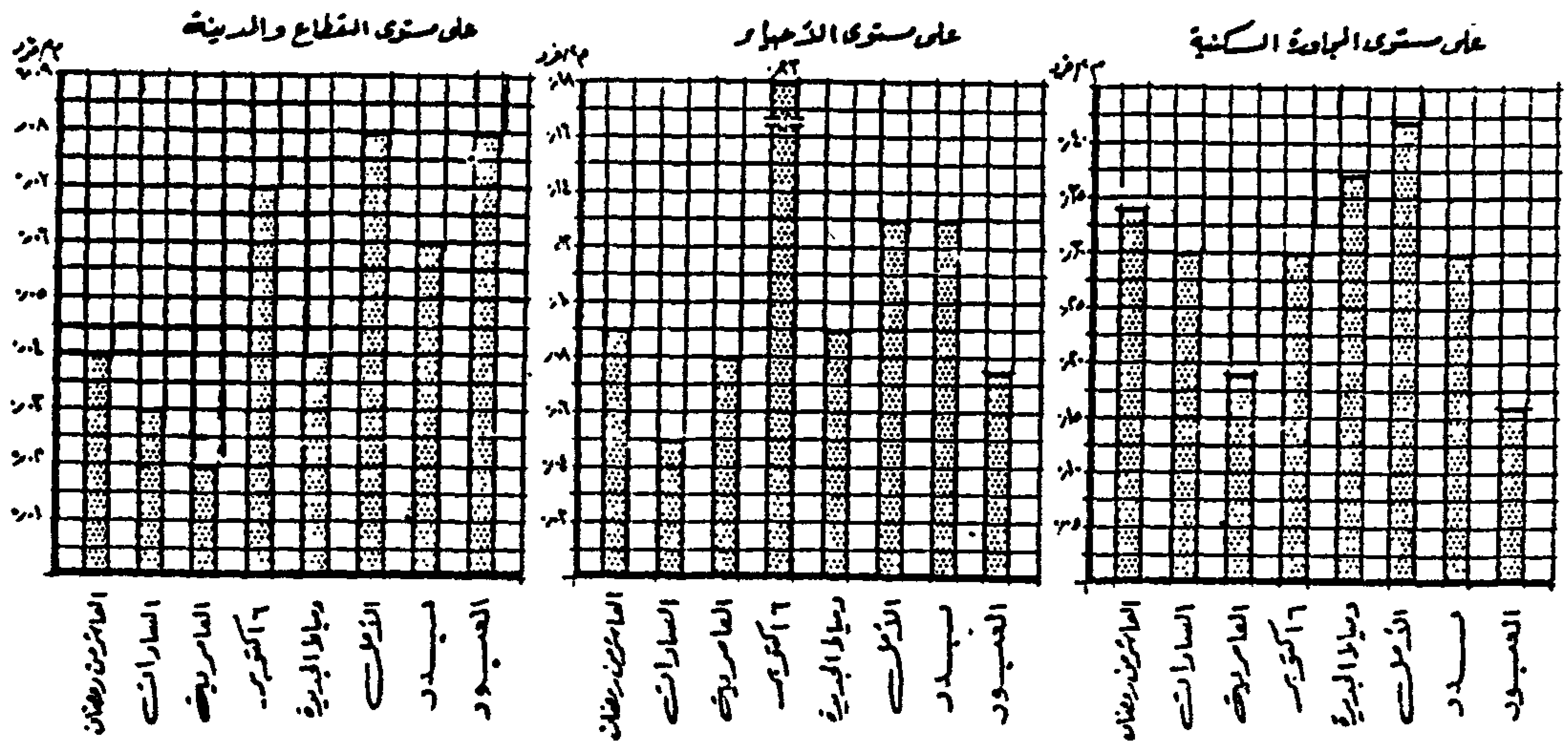
جدول رقم (٦)

الكنائس — جدول رقم (٧)

مستوى الخدمة	وجه المقارنة	العاشر من رمضان	السادات	العامرية	٦ اكتوبر	دمياط الجديدة	الأمل	بدر	العبور
الحى السكنى	مساحة الموقع (م٢)		٧٥٠٠	٤٠٠٠	٦٢٠٠		٦٣٠٠	٥٠٤٠	١٠٠٠
	المساحة المبنية (م٢)		٣٠٠٠	٢٨٠٠	١٧٥٠		١٧٥٠	—	—
	عدد السكان المخدومة (نسمة)		٢٥٠٠٠	٥٠٠٠٠	٥٥٠٠٠		٦٠٠٠٠	٤٢٥٠٠	٨٠٠٠٠
	نصيب الفرد من مساحة الموقع (م٢/فرد)		٠,١٣	٠,٠٨	٠,١١		٠,١	٠,١	٠,٠١٨
	نصيب الفرد من المساحة المبنية (م٢/فرد)		٠,١٢	٠,٠٥٦	٠,٠٣		٠,٠٣		—
القطاع السكنى والمدينة	مساحة الموقع (م٢)	٨٤٠٠	١٠٠٠٠	١٠٠٠٠	٨٤٠٠	٣٨٦٤	١٠٥٠٠	١٠٥٦٠	١٠٠٠٠
	المساحة المبنية (م٢)	٤٠٠٠	٥٠٠٠	١٠٥٠٠	٤٥٠٠	٢٠٠٠	٥٢٥٠	—	—
	عدد السكان المخدومة (نسمة)	٢٥٠٠٠٠	٥٠٠٠٠٠	٥٠٠٠٠٠	٣٥٠٠٠٠	٢٧٠٠٠٠	٢٥٠٠٠٠	٢٤٠٠٠٠	٢٤٠٠٠٠
	نصيب الفرد من مساحة الموقع (م٢/فرد)	٠,٠٣	٠,٠٢	٠,٠٢	٠,٠٢٤	٠,٠١٤	٠,٠٤٢	٠,٠٣	٠,٠٤١
	نصيب الفرد من المساحة المبنية (م٢/فرد)	٠,٠٢	٠,٠١	٠,٠٢١	٠,٠١	٠,٠٠٧	٠,٠٢١		

جدول رقم (٧)

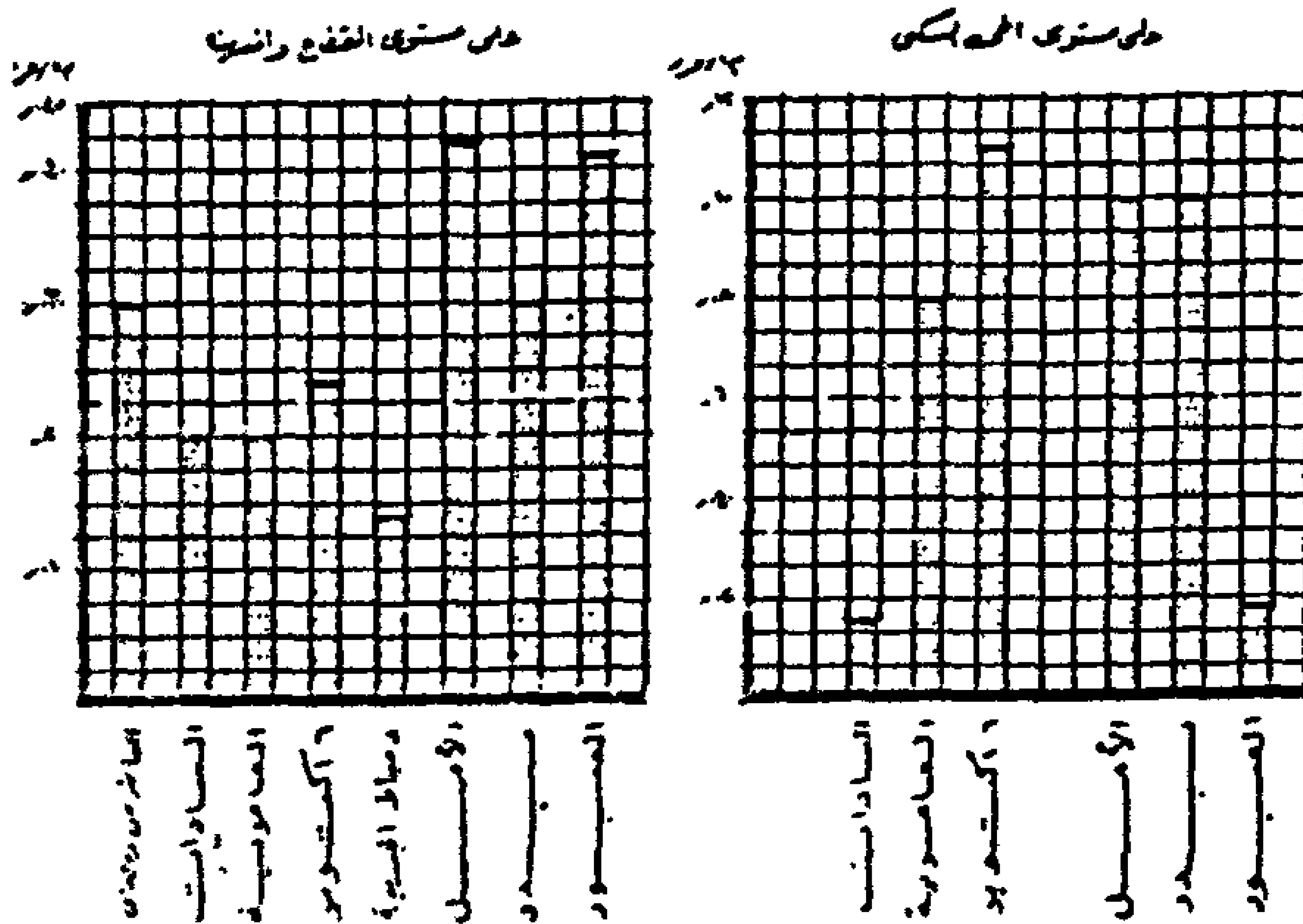
مقارنة نصيب الفرد من مساحة الموقع للخدمات الدينية « المساجد »



شكل رقم (٤)

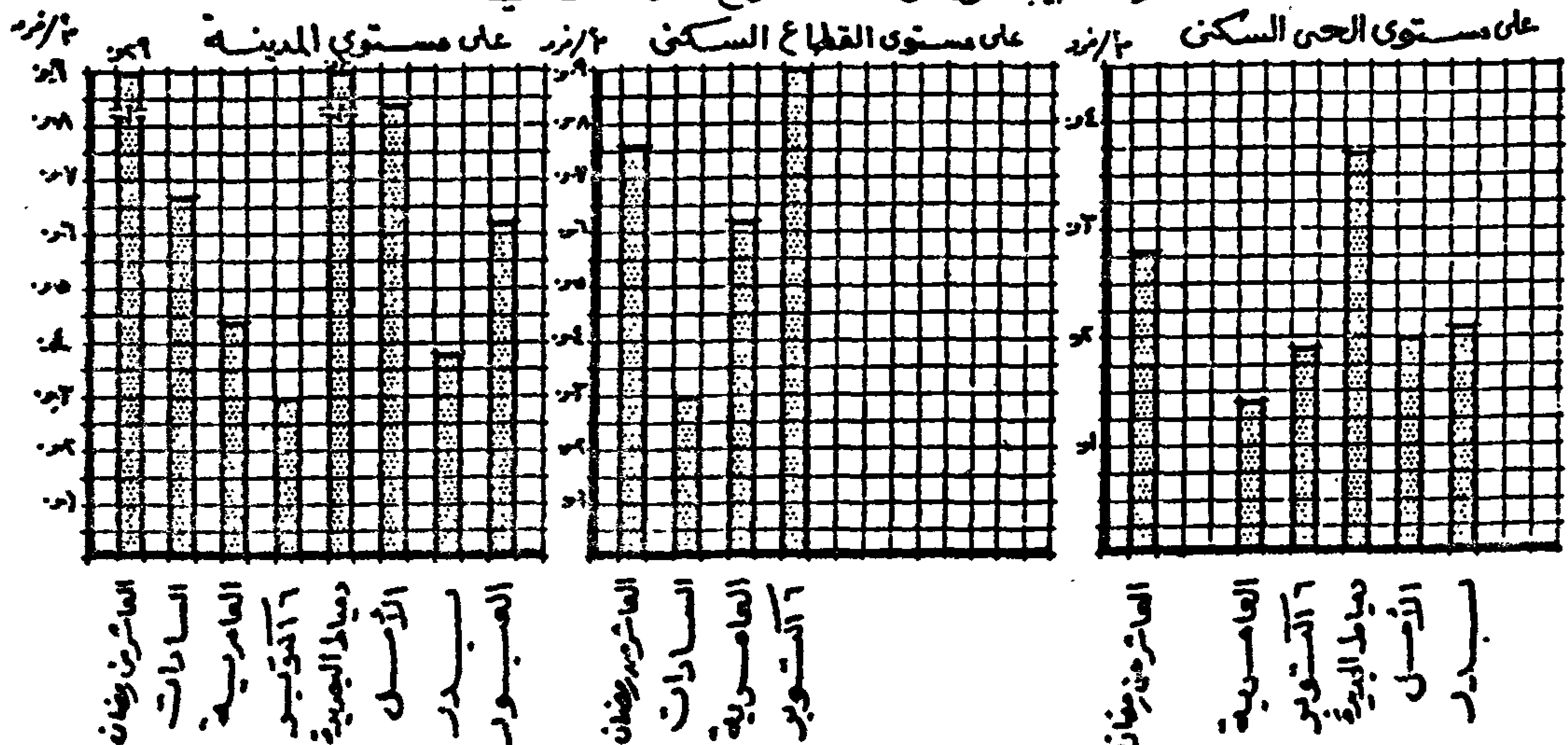
٥ ـ **الخدمات الثقافية** : وهى تتمثل فى المكتبات والسينما والمسرح وقصور الثقافة وكلها تحتاج الى مساحات تختلف من واحدة لأخرى حسب نوع المبنى ولذا تم حساب نصيب الفرد من الخدمات الثقافية بعد تجميع مساحات المنشآت والمبانى الخاصة بالخدمة . وتتوفر هذه الخدمة على المستويات التخطيطية للمدينة عدا مستوى المجاورة السكنية . فعلى مستوى الاحياء السكنية كان اقل نصيب للفرد من مجموع مساحات الموقع ١٤ر٠م٢/ فرد فى مدينة العامرية بينما يصل الى ٣٧ر٠م٢/ فرد فى مدينة دمياط الجديدة . وتتوفر هذه الخدمة على مستوى القطاع السكنى فى أربع مدن فقط من المدن الجديدة المقارنة وكان أقل نصيب للفرد من مجموع مساحات الموقع ٠٣ر٠م٢/ فرد فى مدينة السادات بينما يصل الى ٠٩ر٠م٢/ فرد فى مدينة ٦ اكتوبر . وعلى مستوى المدينة كان أقل نصيب للفرد من مجموع مساحات الموقع ٠٣ر٠م٢/ فرد فى مدينة ٦ اكتوبر بينما يصل الى ٢٩ر٠م٢/ فرد فى مدينة العاشر من رمضان .

مقارنة نصيب الفرد من الخدمات الدينية « الكنائس »



شكل رقم (٥)

مقارنة نصيب الفرد من مساحة الموقع للخدمات الثقافية



شكل رقم (٦)

مقارنة التدرج الهرمى للخدمات الثقافية بالمدن الجديدة

مكتبة وسينما ومسرح وقصور الثقافة

مستوى الخدمة	وجه المقارنة	العاشر من رمضان	السادات	العامرية	٦ اكتوبر	دمياط الجديدة	الأمل	بدر	العبور
الحى السكنى	مجموع مساحات الموقع م٢ .	١٠٥٠٠	٧٥٠٠	٧٠٠٠	٥٢٥٠	١٩٧٩٦	٦٣٠٠	١٠٠٨٠	
	مجموع المساحات المبنية م٢ .	٧٦٠٠	٦١٠٠	٤٠٠٠	٢٠٠٠	١٢٤٣٠	٣٠٠٠		
	عدد السكان المخدومة نسمة .	٣٧٥٠٠	٣٠٠٠٠	٥٠٠٠٠	٢٧٥٠٠	٥٤٠٠٠	٤٠٠٠٠	٤٧٥٠٠	
	نصيب الفرد من مساحة الموقع م٢/فرد	٠,٢٨	٠,٢٥	٠,١٤	٠,١٩	٠,٣٧	٠,٢	٠,٢١	
	نصيب الفرد من مساحة المبنية م٢/فرد	٠,٢٠	٠,٢٠	٠,٠٨	٠,١١	٠,٢٣	٠,٠٨		
القطاع السكنى	مجموع مساحات الموقع م٢ .	١٩٢٠٠	٧٥٠٠	١٠٠٠٠	١٠٥٠٠				
	مجموع المساحات المبنية م٢ .	١٦٧٠٠	٥٥٠٠	٧٨٠٠	٧٠٠٠				
	عدد السكان المخدومة نسمة .	٢٥٠٠٠٠	٢٥٠٠٠٠	١٦٠٠٠٠	١٢٠٠٠٠				
	نصيب الفرد من مساحة الموقع م٢/فرد .	٠,٠٧٦	٠,٣٠	٠,٠٦٣	٠,٠٩				
	نصيب الفرد من مساحة المبنية م٢/فرد .	٠,٠٦٦	٠,٠٢٢	٠,٠٤٨	٠,٠٦				
المدينة	مجموع مساحات الموقع م٢	١٤٥٠٠٠	٣٣٦٥٠	٢٢٠٠٠	١٠٥٠٠	٢٨١١٤٠	٢١٠٠٠	٩٦٦٠	١٥٠٠٠
	مجموع المساحات المبنية م٢	٩٨٠٠	٦١٠٠	٢٢٠٠٠	٧٠٠٠	٤٠٥٨٤			
	عدد السكان المخدومة نسمة .	٥٠٠٠٠٠	٥٠٠٠٠٠	٥٠٠٠٠٠	٣٥٠٠٠٠	٢٧٠٠٠٠	٢٥٠٠٠٠	٢٥٠٠٠٠	٢٤٠٠٠٠
	نصيب الفرد من مساحة الموقع م٢/فرد .	٠,٢٩	٠,٠٦٧	٠,٠٤٤	٠,٠٣	٠,١٠	٠,٠٨٤	٠,٠٣٨	٠,٠٦٢
	نصيب الفرد من المساحة المبنية م٢/فرد	٠,٠٢	٠,١٢	٠,٠٤٦	٠,٠٢	٠,١٥			

ملاحظة : مجموع المساحات هو مجموع مساحة المكتبة + السينما والمسرح وقصر الثقافة .

جدول رقم (٨)

٦ ـ **الخدمات الاجتماعية** : وهى تتمثل فى العديد من المنشآت التى تحتاجها الخدمات الاجتماعية وكذلك تتوزع هذه الخدمة على جميع المستويات التخطيطية للمدينة . ونظرا للعديد من المنشآت الاجتماعية فلايوجد منشأ او مؤسسة اجتماعية واحدة تتوفر فى جميع المدن الجديدة المقارنة فيوجد وحدة اجتماعية على مستوى المجاورة وكان اقل نصيب للفرد من مساحة الموقع ٠,١٣م٢/ فرد فى مدينة العامرية ويتوفر وحدة اجتماعية واحدة لكل مجاورتين بينما يصل نصيب الفرد من مساحة الموقع ٠,٨م٢/ فرد فى مدينة السادات وتتوفر وحدة اجتماعية ضمن مدرسة التعليم الأساسى فى مدينة بدر ويوجد وحدة اجتماعية على مستوى الحى السكنى فى ثلاث مدن فقط من المدن الجديدة المقارنة وكان اقل نصيب للفرد من مساحة الموقع ٠,١٦م٢/ فرد فى مدينتى السادات والعامرية بينما تصل الى ضعف هذه المساحة ٠,٣م٢/ فرد فى مدينة ٦ اكتوبر . والوحدة الاجتماعية على مستوى القطاع السكنى تتوفر فى سبع مدن من المدن الجديدة المقارنة وكان اقل نصيب للفرد من مساحة الموقع ٠,١م٢/ فرد فى مدينتى العاشر من رمضان و ٦ اكتوبر بينما يصل الى ٠,٤م٢/ فرد فى مدينة الامل . والوحدة الاجتماعية على مستوى المدينة تتوفر فى ست مدن من المدن الجديدة المقارنة وكان أقل نصيب للفرد من مساحة الموقع ٠,١م٢/ فرد فى مدينتى العاشر من رمضان والأمل بينما يصل الى ٠,٣٨م٢/ فرد فى مدينة دمياط الجديدة . ويتوفر فى المدن الجديدة منشآت اجتماعية اخرى وهى دار للاحداث للجنسين ويتوفر فى اربع مدن فقط من المدن الجديدة المقارنة وكان أقل نصيب للفرد من مساحة الموقع ٠,٠٠٤م٢/ فرد فى مدينة السادات بينما يصل الى ٠,١٦م٢/ فرد فى مدينة العاشر من رمضان واصلاحية وملجأ للبنين واخرى للبنات وتتوفر فى أربع مدن فقط من المدن الجديدة المقارنة وكان اقل نصيب للفرد من مساحة الموقع ٠,٠٠٢م٢/ فرد بينما يصل الى ٠,٣٢م٢/ فرد فى مدينة العاشر من رمضان ودار للمعوقين ودار آخر للمتخلفين ويتوفرا فى مدينة العامرية فقط ونصيب الفرد من مساحة الموقع لدار المعوقين ٠,٠٠٢م٢/ فرد ودار المتخلفين ٠,٠٠٥م٢/ فرد .

مُقارنة التدرج الهرمى للخدمات الإجتماعية بالمدن الجديدة

جدول رقم ( )

منشآت الخدمة	العاشر من رمضان ١	٢	٣	٤	٥	السادات ١	٢	٣	٤	٥	العامرية ١	٢	٣	٤	٥
وحدة اجتماعية على مستوى المجاورة						[illegible]	[illegible]	٥٠٠٠	[illegible]	[illegible]	على مستوى المجاورة [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
وحدة اجتماعية على مستوى الحى						٥٠٠	١٠٠٠	٣٠٠٠٠	٠٫٠٢	٠٫٠٣٣	٨٠٠	٨٠٠	٥٠٠٠٠	٠٫٠١٦	٠٫٠١٦
وحدة اجتماعية على مستوى القطاع	٣٠٠٠	١٧٥٠	٦٠٠٠٠	٠٫٠٥	٠٫٠٢٩	٣٠٠٠	٦٠٠٠	٦٠٠٠٠	٠٫٠٥	٠٫١	٦٠٠٠	٣٠٠٠	١٢٠٠٠٠	٠٫٠٥	٠٫٠٢٥
وحدة اجتماعية على مستوى المدينة	٣٠٠٠	٦٠٠	٦٠٠٠٠٠	٠٫٠٠٥	٠٫٠٠١	٨٤٠٠	١٢٠٠٠	٤٠٠٠٠٠	٠٫٠١٦٨	٠٫٠٢٨	٨٥٠٠	١٢٠٠٠	٥٠٠٠٠٠	٠٫٠١٧	٠٫٠٢٤
دار للأحداث للجنسين	٤٠٠	١٠٠٠	٦٠٠٠٠	٠٫٠٠٨	٠٫٠٠٨	٤٥٠	٥٠٠	٦٠٠٠٠	٠٫٠٠٧	٠٫٠٠٨					
دار للمسنين	٨٠٠	٧٠٠	٥٠٠٠٠	٠٫٠١٦	٠٫٠١٤	١٠٠٠	٥٠٠	٦٠٠٠٠	٠٫٠٠٢	٠٫٠٠١	١٠٠٠	١٢٠٠	٥٠٠٠٠٠	٠٫٠٠٢	٠٫٠٠٢٤
إصلاحية وملجأ للبنين	١١٠٠	١٧٠٠	٥٠٠٠٠	٠٫٠٢٢	٠٫٠٣٤	٧٥٠	٥٠٠	٦٠٠٠٠	٠٫٠٠١٢	٠٫٠٠٠٨	١٠٠٠	١٢٠٠	٥٠٠٠٠٠	٠٫٠٠٢	٠٫٠٠٢٤
إصلاحية وملجأ للبنات											١٠٠٠	١٢٠٠	٥٠٠٠٠٠	٠٫٠٠٢	٠٫٠٠٢٤
دار للمعوقين											١٠٠٠	٤٥٠	٥٠٠٠٠٠	٠٫٠٠٢	٠٫٠٠١
دار للمتخلفين [illegible]											[illegible]	[illegible]	٥٠٠٠٠٠	[illegible]	[illegible]

منشآت الخدمة	٦ أكتوبر ١	٢	٣	٤	٥	دمياط الجديدة ١	٢	٣	٤	٥	الأمل ١	٢	٣	٤	٥
وحدة اجتماعية على مستوى المجاورة															
وحدة اجتماعية على مستوى الحى	٩٠٠	٨٠٠	٢٧٥٠٠	٠٫٠٣	٠٫٠٢٩										
وحدة اجتماعية على مستوى القطاع	١٥٠٠	٦٠٠	١٢٠٠٠	٠٫١	٠٫٠٥						١٥٠٠	٩٠٠	٦٠٠٠٠	٠٫٠٢	٠٫٠٢
وحدة اجتماعية على مستوى المدينة						١٣٢٠٠	١٣٢٠٠	٢٧٠٠٠٠	٠٫٠٢٨	٠٫٠٢٨	٢٩٤٠		٥٠٠٠٠	٠٫٠١	
دار للأحداث للجنسين	١٠٠٠	١٢٥٠	١٧٥٠٠٠	٠٫٠٠٦	٠٫٠٠٨	٢٥٠٩٤	١٢١٨٨	٢٧٠٠٠٠	٠٫٠٤٤	٠٫٠٤٩					
دار للمسنين	٢١٠٠	١٢٥٠	٢٥٠٠٠٠	٠٫٠٠٦	٠٫٠٠٤										
إصلاحية وملجأ للبنين															
إصلاحية وملجأ للبنات															
دار للمعوقين															
دار للمتخلفين [illegible]															

منشآت الخدمة	بدر ١	٢	٣	٤	٥	العبور ١	٢	٣	٤	٥
وحدة اجتماعية على مستوى المجاورة	ملحق بمدرسة التعليم الأساسى وتخدم ١١٢٥٠ نسمة					٥٠٠		٨٠٠٠	٠٫٠٦٢	
وحدة اجتماعية على مستوى الحى										
وحدة اجتماعية على مستوى القطاع	١٦٨٠		٤٠٠٠٠	٠٫٠٤٢		٧٥٠٠		٤٠٠٠٠	٠٫١٨٧	
وحدة اجتماعية على مستوى المدينة						٨٤٠٠٠		٢٤٠٠٠٠	٠٫٣٥	
دار للأحداث للجنسين										
دار للمسنين										
إصلاحية وملجأ للبنين										
إصلاحية وملجأ للبنات										
دار للمعوقين										
دار للمتخلفين [illegible]										

١- مساحة الموقع (م٢).
٢- المساحة المبنية (م٢).
٣- عدد السكان المخدومة (نسمة).
٤- نصيب الفرد من مساحة الموقع (م٢/فرد).
٥- نصيب الفرد من المساحة المبنية (م٢/فرد).

جدول رقم (٩)

مقارنة نصيب الفرد من مساحة الموقع للخدمات الاجتماعية

على مستوى المجاورة — على مستوى الحى — على مستوى القطاع والمدينة

شكل رقم (٧)

٧ - **الخدمات العامة والادارية**: وتتمثل هذه الخدمة فى المراكز الادارية والبوليس والمطافى والاتصالات السلكية واللاسلكية، وكل منها تحتاج الى مساحة تختلف عن الاخرى والذى تم حساب نصيب الفرد من الخدمات العامة والادارية بعد تجميع مساحات المنشآت والمبانى

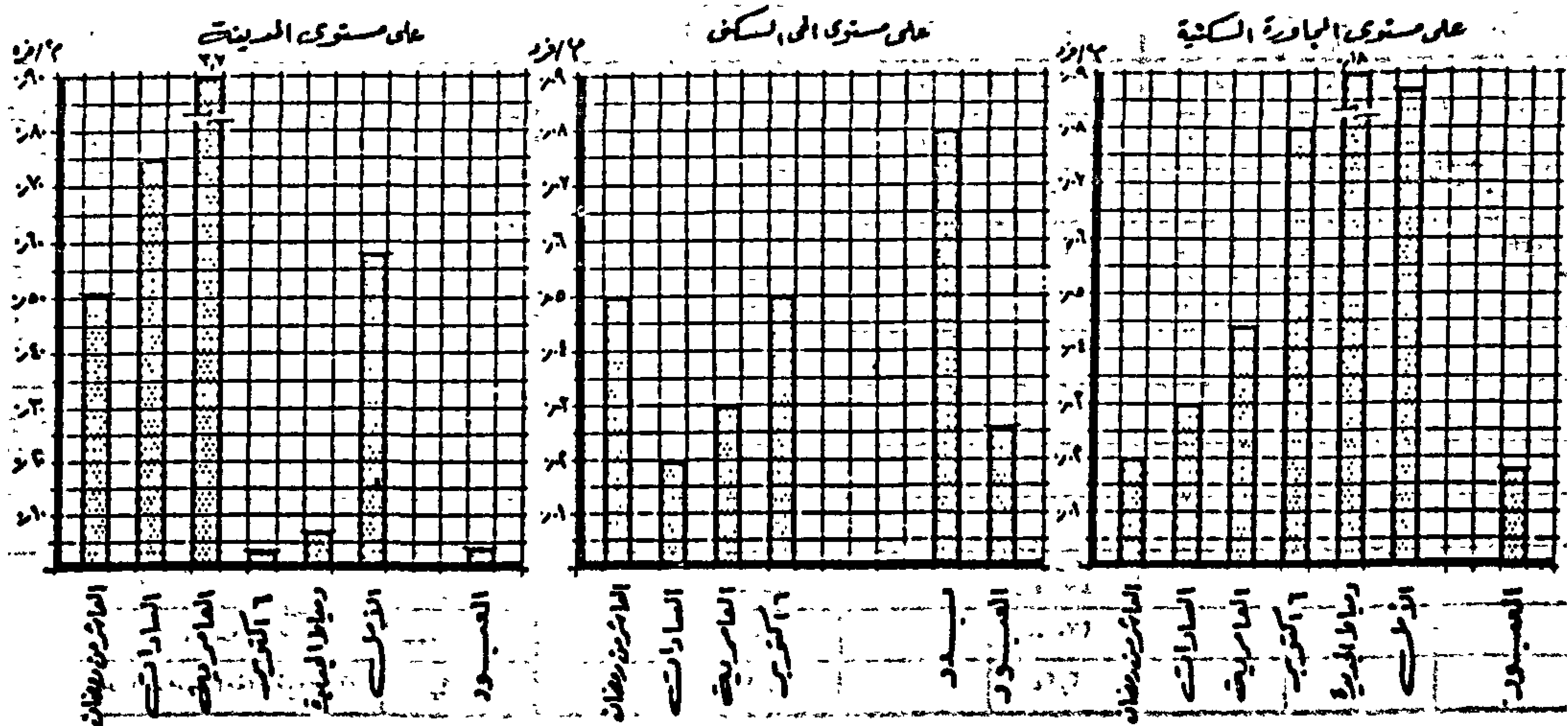
مقارنة التدرج الهرمي للخدمات العامة والإدارية بالمدن الجديدة

(مركز عبد الرحمن والبرلمين والمباني والإتصالات السلكية واللاسلكية) جدول رقم (١٠)

مستوى الخدمة	وجه المقارنة	العاشر من رمضان	السادات	العامرية	٦ أكتوبر	دمياط الجديدة	الأمل	بدر	العبور
المجاورة السكنية	مجموع مساحات الموقع م٢	٢١٠٠	١٠٠٠	٢٢٠٠	٢١٠٠	٩٦٨٠	٣٥٠٠	[illegible]	١٥٠
	مجموع المساحات المبنية م٢	١٢٥٠	١٠٠٠	٢٤٠٠	١٢٥٠	٦٣٠٠	٢٦٥٠		
	عدد السكان المخدومة نسمة	١٢٥٠٠٠	٣٠٠٠٠	٥٠٠٠٠	٢٧٥٠٠	٥٤٠٠٠	٤٠٠٠٠		٨٠٠٠
	نصيب الفرد من مساحة الموقع م٢/فرد	[illegible]	٠٫٠٣	٠٫٠٤٤	٠٫٠٨	٠٫١٨	٠٫٠٨٧		٠٫٠١٨
	نصيب الفرد من المساحة المبنية م٢/فرد	٠٫٠١	٠٫٠٣	٠٫٠٤٨	٠٫٠٥	٠٫١١	٠٫٠٦٦		
القطاع السكني	مجموع مساحات الموقع م٢	١٢٥٠٠	٥٦٠٠٠	٦٠٠٠	٦٠٠٠			٤٢٠٠	١٠٥٠
	مجموع المساحات المبنية م٢	٤٠٠٠	١٢٥٧٥	٩١٠٠	٨٥٠٠				
	عدد السكان المخدومة نسمة	٢٥٠٠٠	٢٥٠٠٠	١٦٠٠٠	١٢٠٠٠			٤٧٥٠٠	٤٠٠٠٠
	نصيب الفرد من مساحة الموقع م٢/فرد	٠٫٠٥	٠٫٠٤	٠٫٠٣	٠٫٠٥			٠٫٠٨	٠٫٠٢٦
	نصيب الفرد من المساحة المبنية م٢/فرد	٠٫١٦	٠٫٠٥	٠٫٠٥	٠٫٠٧				
المدينة	مجموع مساحات الموقع م٢	٢٥٦٠٠٠	٢٧٤٨٥٠	١٨٧٢٠٠٠	١٠٥٠٠	٢٠٥٣٦	١٤٧٠٠	[illegible]	٩٠٠٠
	مجموع المساحات المبنية م٢	٦٥١٢٠٠	١٤٠٣٠٠	١٠٤٠٠٠	٢٢٥٠٠	٢٤٢٦٠			
	عدد السكان المخدومة نسمة	٥٠٠٠٠٠	٥٠٠٠٠٠	٥٠٠٠٠٠	٣٥٠٠٠٠	٢٧٠٠٠٠	٢٥٠٠٠٠		٢٤٠٠٠٠
	نصيب الفرد من مساحة الموقع م٢/فرد	٠٫٥١	٠٫٧٥	٣٫٧	٠٫٠٣٢	٠٫٠٧	٠٫٠٥٨		٠٫٠٢٧
	نصيب الفرد من المساحة المبنية م٢/فرد	١٫٣	٠٫٢٨	٠٫٢	٠٫٠٦٤	٠٫٠٩	[illegible]	[illegible]	

جدول رقم (١٠)

مقارنة نصيب الفرد من مساحة الموقع للخدمات العامة والإدارية



شكل رقم (٨)

الخاصة بالخدمة . فعلى مستوى الحي السكني كان أقل نصيب للفرد من مجموع مساحات الموقع ١٨٠ر م٢/ فرد في مدينة العبور بينما يصل الى ٨٧٠ر م٢/ فرد في مدينة الامل . وعلى مستوى القطاع السكني كان أقل نصيب للفرد من مجموع مساحات الموقع ٢٠ر م٢/ فرد في مدينة السادات بينما يصل الى ٠٫٨ر م٢/ فرد في مدينة بدر . وعلى مستوى المدينة كان اقل نصيب للفرد من مساحة الموقع ٠٣٢ر م٢/ فرد في مدينة ٦ أكتوبر بينما يصل الى ٣٫٧ م٢/ فرد في مدينة العامرية .

٨ ـ الخدمات الترفيهية : وهى تتمثـــل فى الحدائق والملاعب والمناطق المفتوحة وهى موزعة على جميع المستويات التخطيطية للمدينة . فعلى مستوى المجاورة الســكنية كان اقل نصـــيب للفرد من مساحة الموقع ٢رم٢/ فرد فى مدينـــة السادات بينما يصل الى اضعاف هذا المعـــدل ٧٥ر٤م٢/ فرد فى مدينة العاشر من رمضـــــان . وعلى مستوى الحى السكنى كان اقل نصـــــيب مدينة العاشر من رمضان ١٥ر٥م٢/ فرد . ويوجد ايضا ملاعب رياضية فى ثلاث من المدن الجديدة المقارنة وكان نصـيب الفرد فيها من مســـــاحة للفرد من مساحة الموقع ٥رم٢/ فرد فى مدينـــة دمياط الجديدة بينما يصل الى اضعاف هـــذا المعدل ـــر٤م٢/ فرد فى مدينة العبـــور . وعلى مستوى القطاع والمدينة كان اقل نصـــيب للفرد من مساحة الموقع ١١رم٢/ فرد بينما يصل الى ٩٢ر٢م٢/ فرد فى مدينـــة العامرية . ويوجد فى بعض المدن الجديدة المقارنة مناطق مفتوحة وكان نصيب الفرد فى مدينة العامرية ٥رم٢/ فرد وفى الموقع ٤ر٢م٢/ فرد فى مدينة العاشر من رمضان و ٢٤رم٢/ فرد فى مدينـــة العامرية و ٢٤ر٣م٢/ فرد فى مدينة دمياط الجديدة .

مُقَارنة التدرج الهرمى للخدمات الترفيهية والمناطق المفتوحة والملاعب بالمدن الجديدة

الحدائق والملاعب . جدول رقم (١١)

مستوى الخدمة	وجــه المقارنــة	العاشر من رمضان	السادات	العامرية	٦ اكتوبر	دمياط الجديدة	الأمـــل	بـــدر	العبــور
مستوى المجاورة	مساحة الموقع (م٢)	٢٠٩٠٠	١٠٠٠	١٠٠٠٠	١٥٩٦٠	٥٨٥٠	١٢٣٩٠	١٦٨٠٠	٢٠٠٠٠
	عدد السكان المخدومة (نسمة)	٤٤٠٠	٥٠٠٠	٥٥٠٠	٥٠٠٠	٩٠٠٠	٥٠٠٠	١١٢٥٠	١٠٠٠٠
	نصيب الفرد من مساحة الموقع (م٢/فرد)	٤,٧٥	,٢	١,٨٢	٣,٢٠	٠,٦٥	٢,٥	١,٥	٢,٠
مستوى الحى	مساحة الموقع (م٢)	٧٨٧٥٠	١٦٤٥٠	١٦٠٠٠٠	٧١٤٠٠	٢٧٠٠٠	١٠٥٠٠٠	١١٠٨٨٠	١٦٠٠٠٠
	عدد السكان المخدومة (نسمة)	٣٧٥٠٠	٣٠٠٠٠	٥٠٠٠٠	٢٧٥٠٠	٥٤٠٠٠	٤٠٠٠٠	٤٧٥٠٠	٤٠٠٠٠
	نصيب الفرد من مساحة الموقع (م٢/فرد)	٢,١	٠,٥٥	٣,٢	٢,٦	٠,٥	٢,٦	٢,٣	٤,٠
مستوى القطاع والمدينة	مساحة الموقع (م٢)	٥٢٥٠٠٠	٥٤٣٩٠٠	١٤٦٠٠٠٠	٥٧٩٦٠٠	٣١١٢٢	٥٢٥٠٠٠	٥٠٤٠٠٠	٦٥٠٠٠٠
	عدد السكان المخدومة (نسمة)	٢٥٠٠٠٠	٥٠٠٠٠٠	٥٠٠٠٠٠	٣٥٠٠٠٠	.٢٢٠٠٠٠	٢٥٠٠٠٠	٢٥٠٠٠٠	٢٤٠٠٠٠
	نصيب الفرد من مساحة الموقع (م٢/فرد)	٢,١	١,٠٩	٢,٩٢	١,٦٦	٠,١١	٢,١	٢,٠	٢,٧١
المناطق المفتوحة	مساحة الموقع (م٢)	أحراش مشاه ٢٢٦٦٠		حديقة للسائحين ٢٥٠٠٠٠					
	عدد السكان المخدومة (نسمة)	٤٤٠٠		٥٠٠٠٠٠					
	نصيب الفرد من مساحة الموقع (م٢/فرد)	٥,١٥		٠,٥					
أخرى	مساحة الموقع (م٢)	نادى رياضى ٣٠٠٠٠		مجمع رياضى ١٢٠٠٠٠		استاد رياضى ٨٧٤٨٠٠			
	عدد السكان المخدومة (نسمة)	٧٥٠٠٠		٥٠٠٠٠٠		٢٧٠٠٠٠			
	نصيب الفرد من مساحة الموقع (م٢/فرد)	٠,٤		٠,٢٤		٣,٢٤			

جدول رقم (١١)

وبعد مقارنة كل خدمة على حـــدة بين المدن الجديدة نســـتعرض فيما يأتى مقارنة لنصـيب الفرد لكل خدمة من مســـاحة الموقـــع بالمـــدن الجـــديدة حيث اجمالى نصـــيب الفرد على مستوى المجاورة السكنية والحى السكنى والقطاع والمدينة من مساحة الموقع لكل خدمة ثم اخيرا اجمالى نصيب الفرد من الخدمة (م٢/ فرد) .

مقارنة نصيب الفرد من مساحة الموقع للخدمات الترفيهية ـ المناطق الخضراء ـ

حديقة المجاورة — حديقة الحى — حديقة القطاع والمدينة (م٢/فرد)

العاشر من رمضان — السادات — العامرية — ٦ أكتوبر — دمياط الجديدة — الأمل — بدر — العبور

شكل رقم (٩)

مقارنة مصيب الفرد لكل خدمة من مساحة الموقع بالمدن الجديدة

جدول رقم (١٢)

نوع الخدمة	المستوى	العاشر من رمضان	السادات	العامرية	٦ أكتوبر	دمياط الجديدة	الأمل	بدر	العبور
التعليمية	١	٤,٤٧	٢,٥٢	٤,٢٤	٣,٣٦	٢,٣	٣,٠	٤,٢٧	٤,٠٦
	٢	٤,٠٥	٠,٦٦	٢,٢	٣,٠٠	٠,٩٤	٠,٣٠	١,٦٦	٠,٨
	٣	٠,٤٤	٠,٣٩			١,٧٧	٠,١٦	٠,١١	٠,١
	٤	٤,٣٦	٣,٣٧	٧,٠٤	٦,٧٦	٤,٨١	٤,٢١	٣,٥٩	٤,٩٦
الصحية	١	–	–	–	–	–	–	–	–
	٢	٠,١٧	٠,١	٠,٠٥	٠,٠٢	٠,٠٢	٠,٠٥	٠,٠٥	٠,٢٢
	٣	٠,٠٧	٠,٠٣	٠,٢٢	٠,١١	٠,٠٢	٠,٢	٠,٢٦	٠,١٧
	٤	٠,٢٩	٠,٤	٠,٢٨	٠,٤٨	٠,٤	٠,٢٥	٠,٣١	٠,٧٤
التجارية	١	٠,٠٩	٠,١١	٠,٠٥	١,٢٦	٠,٦٨	١,٦٨	٠,٠٥	٠,١٨
	٢	٠,٦١	٠,١٨	٠,٠٦	٠,١١	٠,٤٤	٠,٨٤	٠,٧٣	٠,٢٥
	٣	٠,٤٩	٠,٩٩	٠,٧٩	٠,١	٠,٩٢	٠,٠٨	٠,١٩	٠,٢٨
	٤	٢,٠٣	١,٥٨	١,٨٩	٣,٠٧	٢,٠٨	٢,٦	١,٤٢	٠,٧١
الدينية	١	٠,٣٤	٠,٤٦	٠,٠٢	٠,٤	٠,٣٦	٠,١٤	٠,٢٦	٠,١٦
	٢	٠,٠٩	٠,٠٥	٠,١٦	٠,٢٤	٠,٠٩	٠,٠٢	٠,٤٤	٠,١١
	٣	٠,١١	٠,٠٩	٠,٠٥	٠,٠٩	٠,٠٩	٠,١٢	٠,٠٩	٠,١٢
	٤	٠,٤٦	٠,٦	٠,١١	٠,٨٣	٠,٥٤	٠,٧٤	٠,٥٩	٠,٣٩
الثقافية	١	–	–	–	–	–	–	–	–
	٢	٠,١٦	٠,٢٥	٠,١٤	٠,٢٢	٠,٢٦	٠,١٥	٠,٢	
	٣	٠,٠٩	٠,٠٨	٠,٠٦	٠,٠٩	٠,٤١	٠,٠٨	٠,٠٣	٠,٠٦
	٤	٠,٢٥	٠,٣٣	٠,٢٠	٠,٣١	٠,٥٢	٠,٢٣	٠,٢٣	٠,٠٦
الاجتماعية	١	٠,٠٥	٠,٠٨	٠,٠٣	–	–	–	–	٠,١٦
	٢	٠,٥	٠,٠١	٠,٠١	٠,٠٥	–	٠,٠٣	٠,٠٣	٠,١٨
	٣	٠,٠٨	٠,١١	٠,٠٣	٠,٠٣	٠,٠٦	٠,٠٢		٠,٠٣
	٤	٠,٠٨	٠,٢٣	٠,٠٧	٠,٠٨	٠,٠٦	٠,٠٥	٠,٠٣	٠,٢٧
الإدارية والأمنية	١	–	٠,٠٩	–	–	–	–	–	–
	٢	٠,٠٠٥	٠,٠١	٠,٠٤	٠,٠٢	٠,١٨	٠,٠٠٥	٠,٠٨	٠,٠٢
	٣	١,٨١	٠,٣٦	٢,٠٧	٠,١٥	٠,١٣	٠,٠٨	٠,٠٩	٠,٠٣
	٤	١,٨٦	٠,٨٤	٣,٢٤	٠,٢٢	٠,٢١	٠,١٣	٠,١٧	٠,٠٦
الترفيهية	١	٤,٣٥	٠,٢	٤,٨	٣,١٦	٠,٦٥	٤,٥	١,٥	٤,٠
	٢	٤,٠	٠,٥٥	٣,٢	٤,٦	٠,٥	٤,٦	٤,٣	٤,٠
	٣	٢,٥٠	١,٠٨	٢,٦٦	١,١٥	٠,٨٢	٢,١	٤,٠	٤,٢
	٤	٨,٩٥	١,٨٣	٩,٦٦	٧,٤١	١,٩٢	٧,٤	٥,٨	٨,٧

١- نصيب الفرد على مستوى المجاورة السكنية.
٢- " " " " الحى السكنى.
٣- " " " " القطاع والمدينة.
٤- إجمالى نصيب الفرد من الخدمة = م٢/فرد.

جدول رقم (١٢)

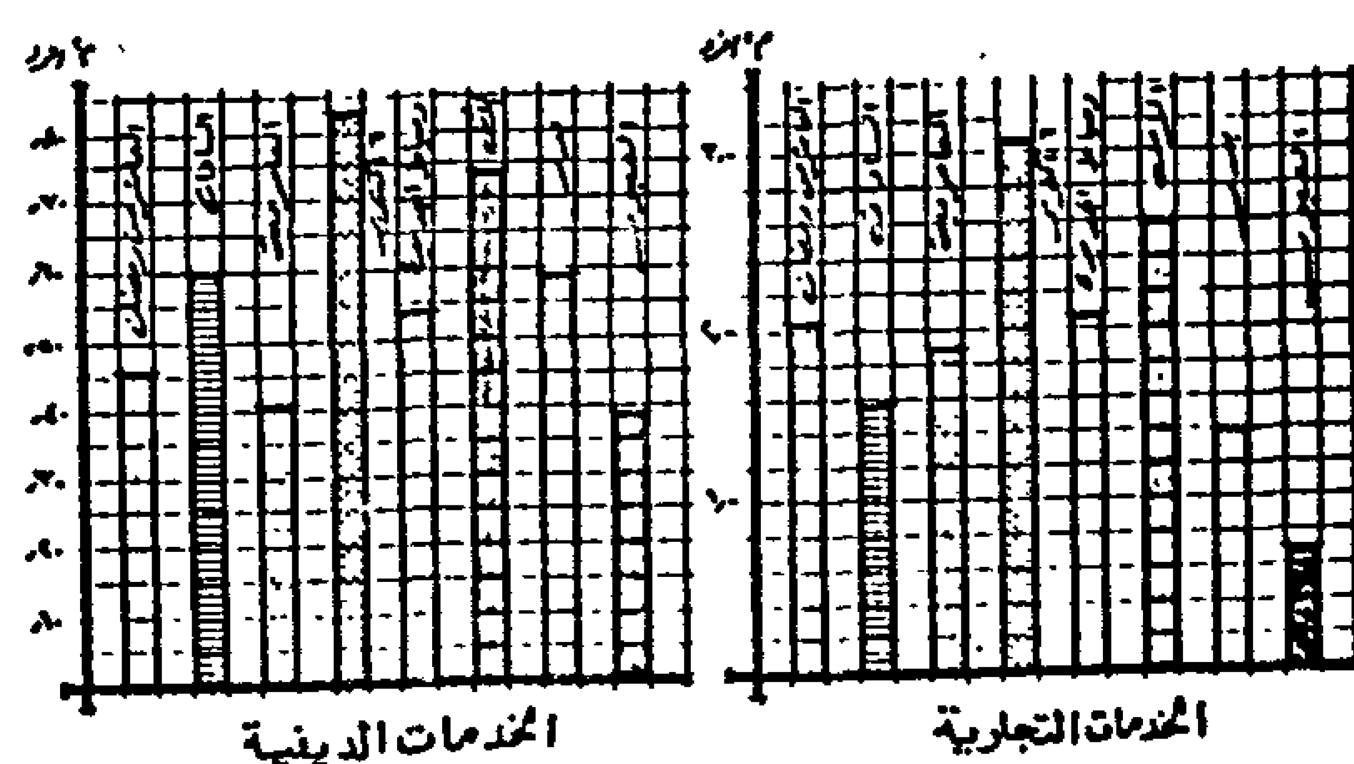
مقارنة معدلات نصيب الفرد من الخدمات م٢/فرد

الخدمات التعليمية

شكل رقم (١٠)

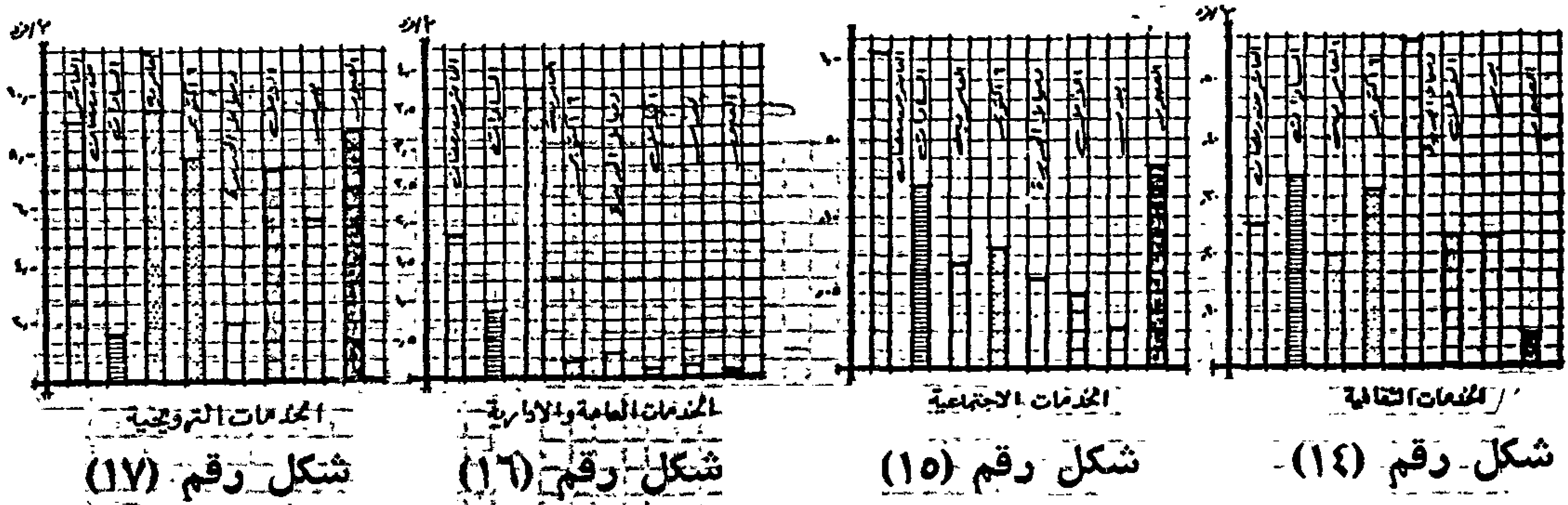
الخدمات الصحية

شكل رقم (١١)



شكل رقم (١٢)

شكل رقم (١٣)



شكل رقم (١٤) شكل رقم (١٥) شكل رقم (١٦) شكل رقم (١٧)

ملحوظة : جميع الارقام الواردة بالجداول السابقة جمعت من واقع تقارير المدن الجديدة وانها حسبت بمعرفة الباحث .

المراجــع :

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ـ مدينة ٦ اكتوبر : الهيئة العامة للتخطيط العمراني ١٩٨٤ .

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in hydrocarbon structure, migration of hydrocarbons, and tectonic history including rates of deposition, depth of burial, all being affected through time. Therefore, time is a modifying factor, which similar to temperature, aids oil forming processes.

Volumes of gas and oil reserves has an inverse relation with increasing depth There are of course exceptions where the productive area of oil the productive area of oil and gas bearing formations increases with depth. (see Blank et. al. 1964). Such exception seem to be related to the depositional history of the source rocks at different times in the basinal history.

Where depositional environments were similar through time, downward increase in temperature causes phasing out of oil and dominance of gas.

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sity with increasing depth, temperature, and time. At shallow depths there is rapid loss in prosity, and with increasing overburden pressure the rate of loss in porosity diminishes greatly. Maxwell (1964) has demonstrated this relationship for sandstones. This relationship is plotted which along with thermal gradients provides a clastic - hydrocarbon model (Fig. 12).

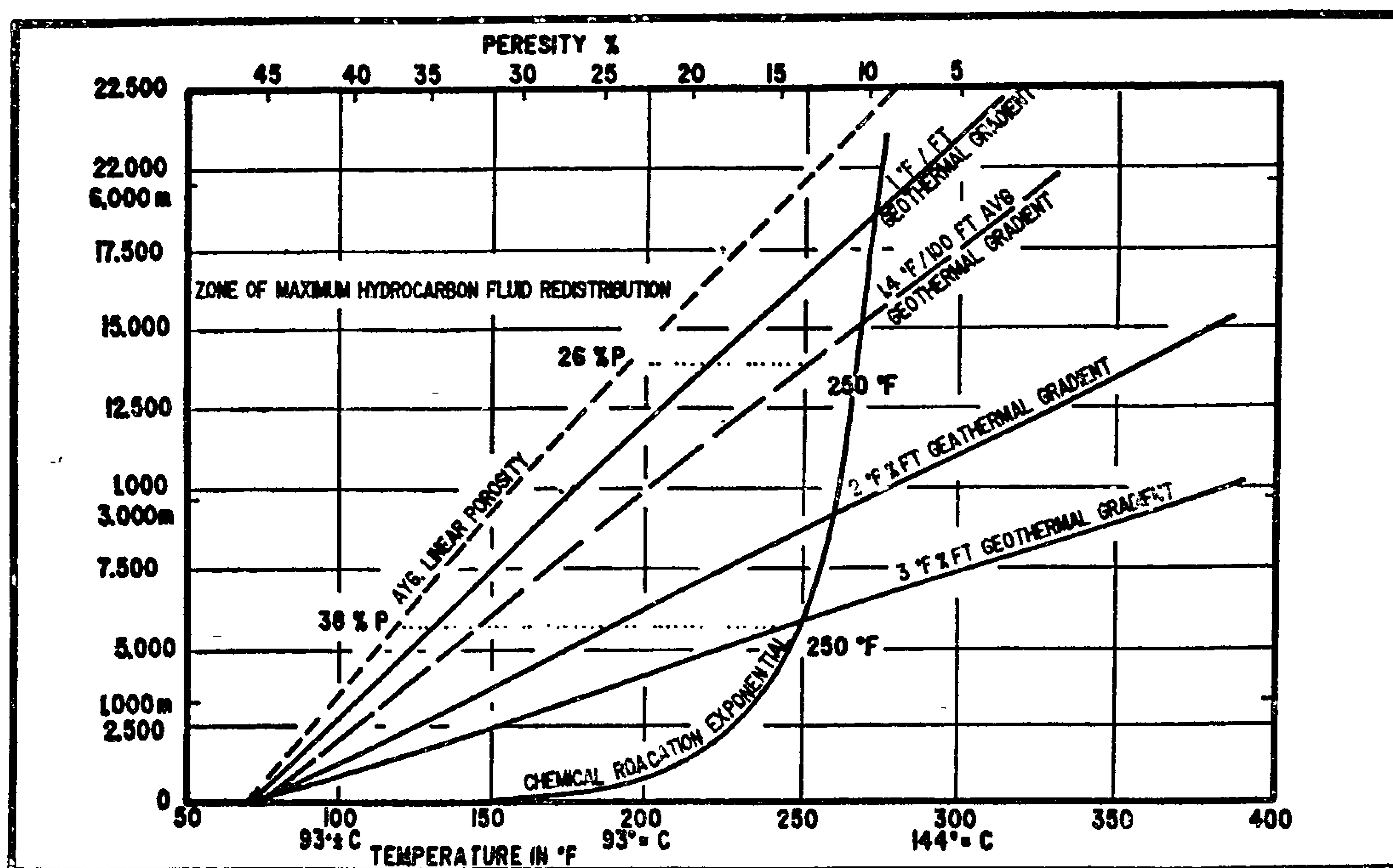


Fig. 12 : Clastic/hydrocarbon model

From this model, several observations can be made :

With temperature providing an exponential curve for chemical reactions in petroleum genesis, and the greater mobility of water expulsion from clay Lattic being linked to higher thermal gradients as opposed to the linear decrease in porosity with depth, it is apparent that a relatively high geothermal gradient enhances the early formation of oil at relatively shallow depths. This relationship may be clearly demonstrated in clastic sequences, but cannot applied to carbonate sequences. Porosity is also influenced by geothermal gradient there being almost twice the pore space available with a high gradient than is available with a normal gradient. Alternatively, the maximum fluid redistribution zone (Fig. 12) shows that with a thermal gradient of 3°F per 100 feet, oil will enter rock at 3700 feet with porosities of 42%, which is 60% more space than is available with 1°F/100 feet thermal gradient at 13000 feet. So, where similar traps exist, theoritically, a higher geothermal gradient might result in more than twice the petroleum accumulation of a low geothermal gradient due not only to there being more pore space, but due also to decreased viscosity, increased pressure and higher permeabilities in carrier beds.

We may conclude that in the presence of all the geologic factors necessary for the formation and entrapment of hydrocarbons in a basin; the basin with the higher geothermal gradient will have the more efficient oil forming enviroment.

Time, since it is primarily concerned with temperature appears to have an important influence on petroleum formation, compaction, of sediments, changes

Fig. 10, illustrated the process of formation of petroleum as a function of progressive burial of rocks containing organic matter in sedimentary basins. This is in complete agreement with the studies of many researchers, on several sedimentary basins, e.g. Larskaya and Zhabrev (1964) Philippi (1965). They noted an increase with depth of the bitumen ratio and hydrocarbon ratio accompanied by an increase in carbon content of the total extracted bitumen (Fig. 11).

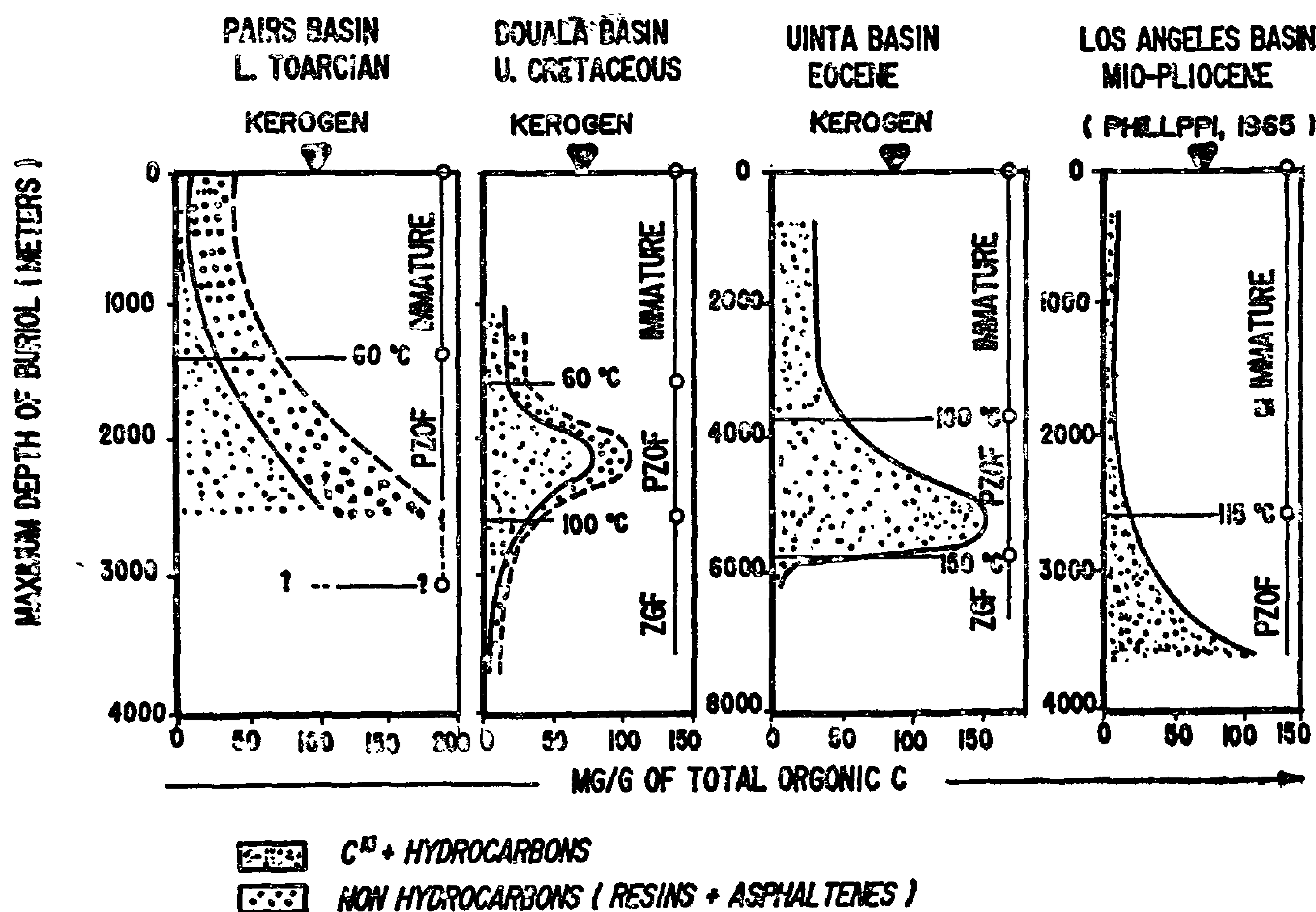


Fig. 11. : Formation of hydrocarbons andnonhydrocarbons (resins and asphaltenes containing N, S, O) as a function of bu-rial depth, in different basins. The major steps of evolution of the organic matter are marked: «immature», «PZOF» (prin cipal zone of oil formation and «ZGF» (zone of gas formation by cracking). Corresponding temperature are shown accrding to present geothermal gradients. (From Tissot et. al., 1978).

Following the early diagenesis of organic matter in young sediments, subsequent evolution will thus include the successive steps :

a) diagenesis :
an immature stage with little change : hydrocarbons are scarce. They are more or less directly inherited from living organisms and comparable to the molecules present in the young sediment.

b) categenesis :
the principal zone of oil formation the zone of gas formation, where wet gas with increasing proportion of methane is generated in large amounts through cracking.

c) metagenesis :

some additional generation of hydrocarbons (mainly mthane) from kerogen; liquid hydrocarbons previously generated are also cracked and converted to gas.

OIL OCCURENCE :

Compaction in sediments results in an increase in bulk density and loss of pro-

shearing or folding presures developed tectonically may locally have much more potent than gravitational pressure.

In general, it is hard to name indigenous oil occurrences which do not appear at some time to have had overburden pressures of at least 2000 to 3000 feet; oil accumulation can only become important under an overburden equivalent to at least - 3000 - 6000 feet. However, Teas and Miller (1933) concluded that the origin and accumulation of oil at Raccoon Bend took place in the Gutowskey sand under an overburden equivalent to only 450 feet of the presently overlying section. Kidwell and Hunt (1958), found evidence for concentration of petroleum - like hydrocarbons in a sand lens in Recent clays at a depth of only 110 ft.

Another physical parameter increasing with depth is temperature. The increase of temperature with burial depth is a consequence of the transfer of thermal energy from the interior of the earth to the surface where it is dissipated. Different goethermal gradients (°C Km - 1) are observed, depending upon the overall thermal conductivity of the rock strata, regional heat flow conditions, and subsurface water movement. The variation in geothermal gradients in sedimentary basins is typically in the range of 15 °C./Km to 50°C. Km, although gradients as low 5°C./Km and as high as 77°C./Km and in special situations up to 90°C./Km, have been observed (see Tisst et al., 1978. Generally stable, old cratonic parts of the earth crust with crystalline rocks have lower geothermal gradients; and young, orogenic and active rifting areas have higher geothermal gradients with the exception of "arc-trench gabs" of active margins where gradients may be as low as 10°C./Km (Lee and Uyeda, 1965). A world average geothermal gradient is considered to be 25°C./Km.

For given organic material initially deposited, the attainment of aparticular degree of transformation would be at a depth which is a function of the rate of burial and the geothermal gradient for the area. Tissot et al. (1971) has given a case in which the maximum amount of oil would have been generated when depth of burial was about 2500 m, very little having been formed by burial to 1000 m. This is associated with a shift in the peak amount of n-paraffins from about C_{26} when the depth was some 400 m, to a peak at C_{15} at 2500 m. Over the same depth range the marked odd dominance for the n-paraffins seen at 400 m had disappeared at 2500 m; there are also changes in the distribution of the naphthenes with given numbers of rings. From 2500 m downwards the quantity of oil is reduced whereas the amount of hydrocarbon gas increases, and at about 4000m the oil has disappeared, leaving onlymethane in the gas (Fig. 10).

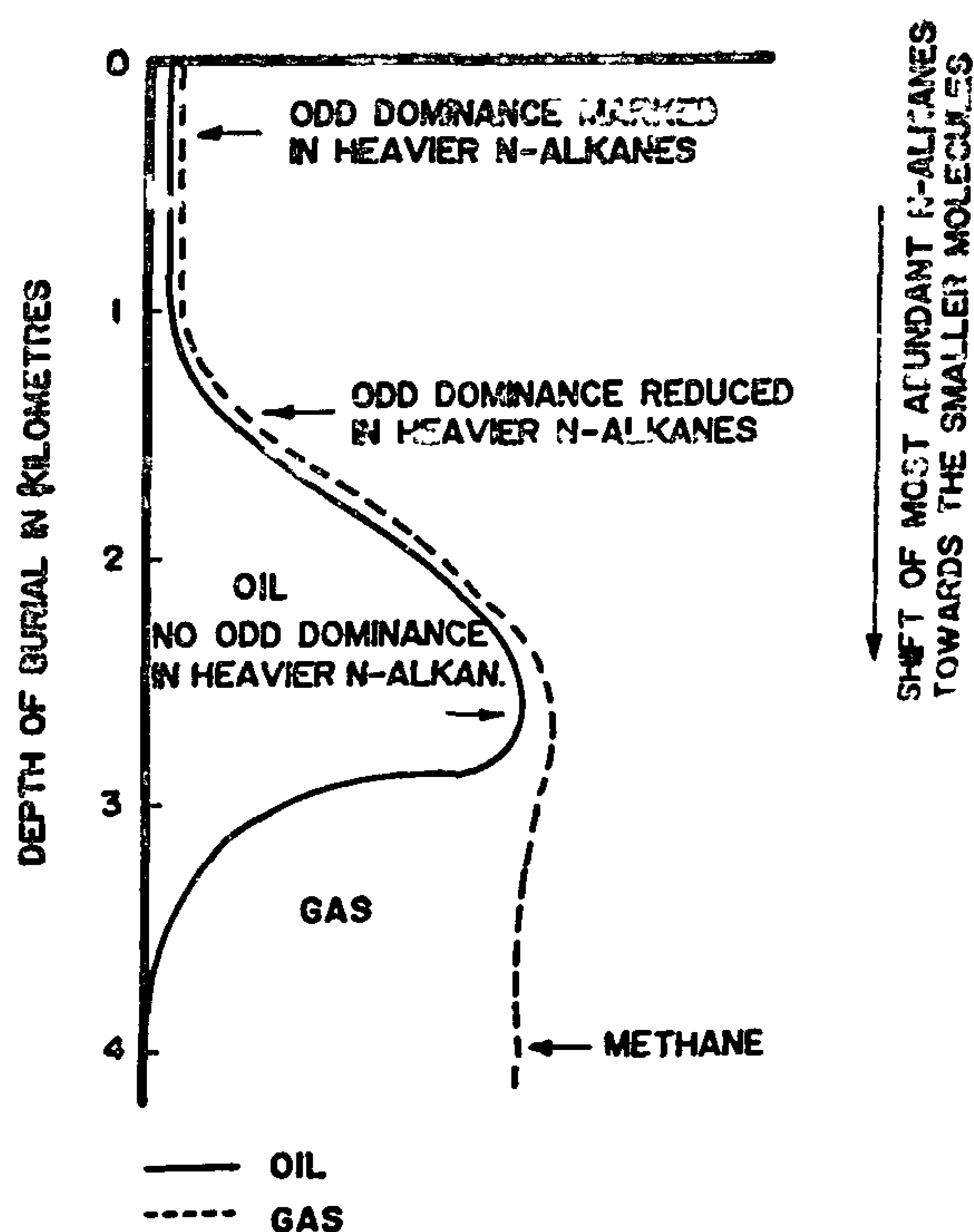


Fig. 10 : Hydrocarbon formation on progressive burial of rocks containing petroleum-forming organic matter. (Based on Tissot, 1971).

1 — As a function of temperature, a progressive increase of liquid bitumen generation followed by a decrease of liquid bitumen explained by cracking and massive generation of light hydrocarbons.

2 — Kerogen is able to form petroleum constituents under temperature increase and there is a strong evidence that mild thermal degradation of kerogen is the principle mechanism by which most hydrocarbons are produced.

3 — Time may replace temperature in the conversion process of organic matter to petroleum.

4 — Natural catalysts in the sediments may favour reactions at much lower temperatures than might seem possible from laboratory experiments.

Laboratory experiments, however, are not able to simulate natural diagenesis, as there probably important factors other than temperature at that stage. Tissot et al. (1978), stated that the experiments provide a convenient simulation of catagenesis (Fig. 6) with respect to kerogen evolution and they pointed out the role temperatures over a short time range - on the catagenetic transformation of kerogen. So, it would seem that some oil has definitely been formed naturally at high temperatures. This situation has been reported by Hedberg (1964) and McIver(1967) and occurs in South Africa, Southern Colorado, Argentina,..... . etc.

This seems in complete agreement with the opinion of Sokolov et al. (1963); they have stated that «the liquid and gaseous hydrocarbons constituting the bulk of the oil are formed not in the early stage of of the existence of sedimentary deposits but much later in the stage of catagenesis where thermocatalytic disintegration of organic matter at higher temperatures and pressures or some process of synthesis will lead to form liquid and heavy gaseous hydrocarbons and their various derivatives.

EFFECT OF DEPTH, TEMPERATURE AND GEOTHERMAL GRADIENT ON OIL GENERATION AND OCCURENCE

Petrolium has been found from the surface down to 25000 ft, and at temperatures ranging up to 180°C. Current commercial production ranges from a few hundred feet to a depth around of 21000 feet. The world average depth of major hydrocarbon deposits is 48% above 6000 feet, 43% between 6000 and 9000 feet, and 9% below 9000 feet (Klemme, 1972).

It has often been suggested that there is a minimum depth of burial required for the formation of petrolium and that indigenous oil can not be expected in rocks which have never been under more than a certain amount of overburden, placed variously at from, 1000 to 5000 feet by different authors. One of the physical parameters increasing with depth is pressure, however, there seems to be little reason in direct pressure effects alone for postulating any minimum depth of burial requirement, except as overburden pressure facilitates the expression of fluids from compactible sediments and as increased fluid pressure may promote solution of petroleum constituents.

The role of pressure has been studied in experiments on Lower Toarcian shales of the Paris Basin (Debyser and Oudin, Durand, in Tissot and Pelet, 1971); samples from various depths in the basin were heated with geostatic pressure varying from a few bars up to 800 bars. The hydrocarbons generated are apparently of the same order of magnitude at all pressures studied. Heterocompounds, such as resins and asphaltenes, might be slightly less abundant under high pressures This is an indication of the relatively subordinate role of pressure in the formation of oil,. It is possible, however, that differential pressures between the solid and liquid phases in a sediment may have played a role and it is also possible that

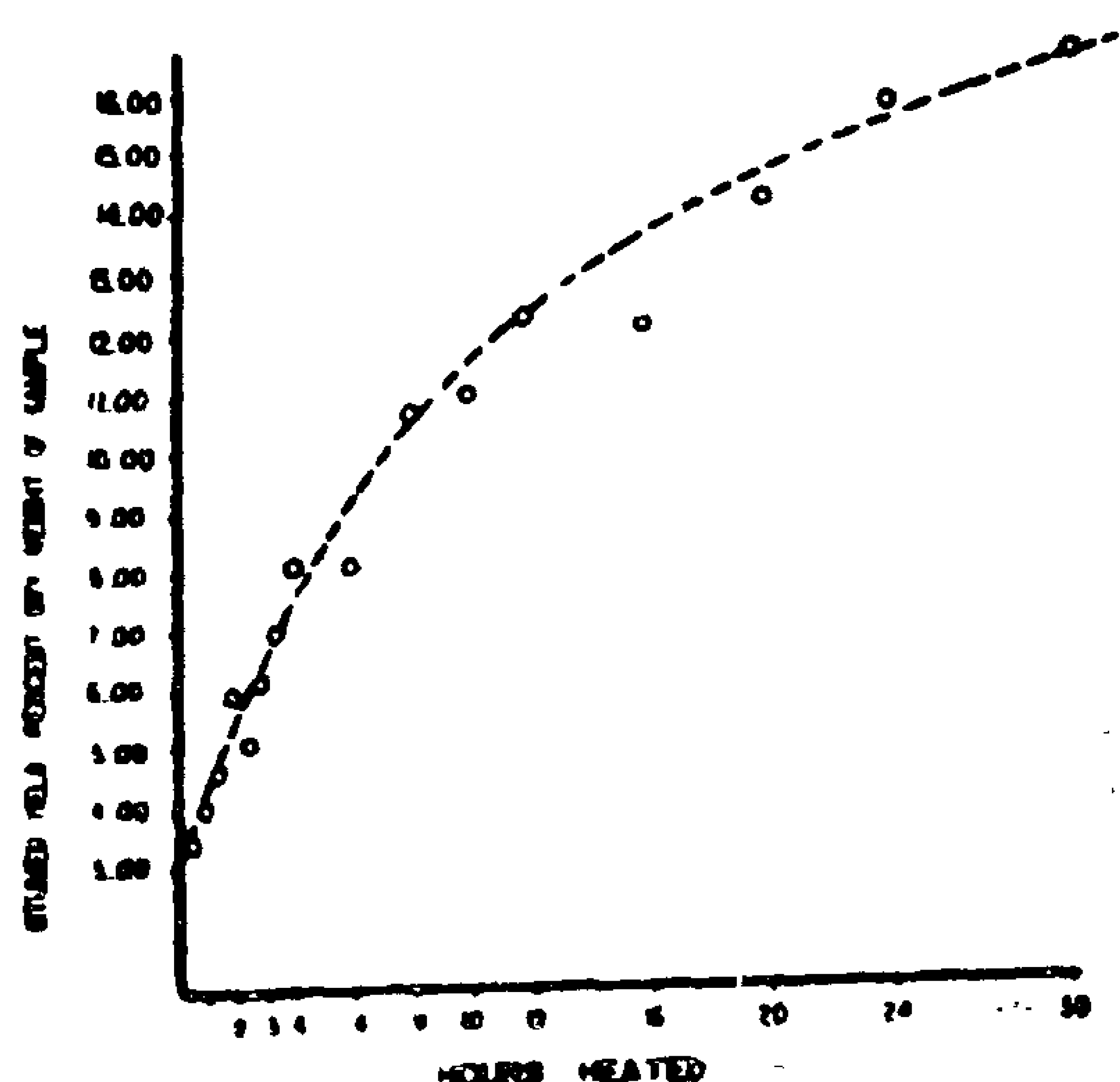


Fig.9 , Bitumen formation at 350°C.

Discussion Of Results:

Curves showing the amount of bitumen produced during various intervals of time are plotted from the results obtained at the temperatures employed (Figs 7a, 7b, 8, and 9). The slope of such curves pictures the rate of conversion. At temperatures of 150° and 250°C., the trend of the curves obtained is concave upward, showing that the maximum rate of conversion was not achieved during the time that the samples were heated. Near the beginning of the heating period, initial gains in bitumen yield were followed in each case by slight declines and then, later, by regular increases. This reduction in yield was less at the higher temperature.

At temperatures of 300° and 350°C., the curves obtained are convex upward and, showing that the time of heating was more than sufficient to produce the maximum rate of conversion at these temperatures. No break in the initial rate of yield was shown.

It will be evident from the foregoing discussion and data that;

— Decomposition of bitumen already present in the shale is believed to have caused the initially decreased yields in samples heated at the lower temperatures.

— Formation of new bitumen at a rate exceeding that at which the material is volatilized apparently begins when the vapour pressure of the gases evolved reaches a critical point for the temperature maintained.

— In so far as increases in temperature speed up the reactions involved, conditions favouring the formation of bitumen are the more quickly attained.

Abeson (1963), studied the role of time in the transformation process and stated that time may replace temperature and that, given adequate time decarboxylation at temperature below 100°C. may accomplish substantial conversion to petroleum. Debyser and Oudin, Durand (in Tissot and Pelet, 1971), studied immature samples from the Lower Toarcian shales of the Paris Basin to determine the influence of time and temperature on bitumen and hydrocarbon generation: after 90, 180, and 270 days, the amount generated was about three times more at 220°C. than at 180°C., table 2.

Table 2 Bitumen (hydrocarbons + resins + asphaltenes) generated by heating Lower Toarcian shales of the Paris Basin at 180, 200, and 220°C.

Time (days)	Bitumen generated (mg/g of original organic carbon)		
	at 180°C	at 200°C	at 220°C
1	5.9	6.8	9.2
3	6.6	8.7	13.1
10	6.6	9.2	14.0
30	8.8	14.8	21.4
90	10.4	12.2	30.0
180	10.7	22.2	30.4
270	12.8	21.2	36.2

Conclusion:

It will be evident from the forgoing discussion and data that the results of heating experiments are in agreement with the mechanisms of petroleum generation deduced from the observations of case histories in sedimentary basins, the main results may be summarized as follows:

Quantitative determinations of the amount of soluble bitumen formed from the organic matter in Colorado shale during various periods of time at temperatures of 150°, 250°, 300 , and 350 C., and under otherwise similar conditions, were made by J.E. Hawley. The results obtained are illustrated by figures 6,7,8, and 9

In tests made at 150°C, individual samples were heated in sealed glass bombs for periods of time from 3 hours to more than 32 days. Some of the sealed bombs were evacuated, and some were sealed without evacuation of air. Both groups were heated for the same lengths of time Several of the samples heated in vacuum at 150°C. showed low and irregular yields of bitumen. Both in the evacuated and in the non-evacuated bombs, heating produced initial losses in the yields of soluble bitumens during the first few hours. These losses were followed, especially in the case of these samples heated in the presence of some air, by yields which increased in amount to the length of the heating period. Samples from the evacuated bombs showed slightly lower yields (Fig. 7 a).

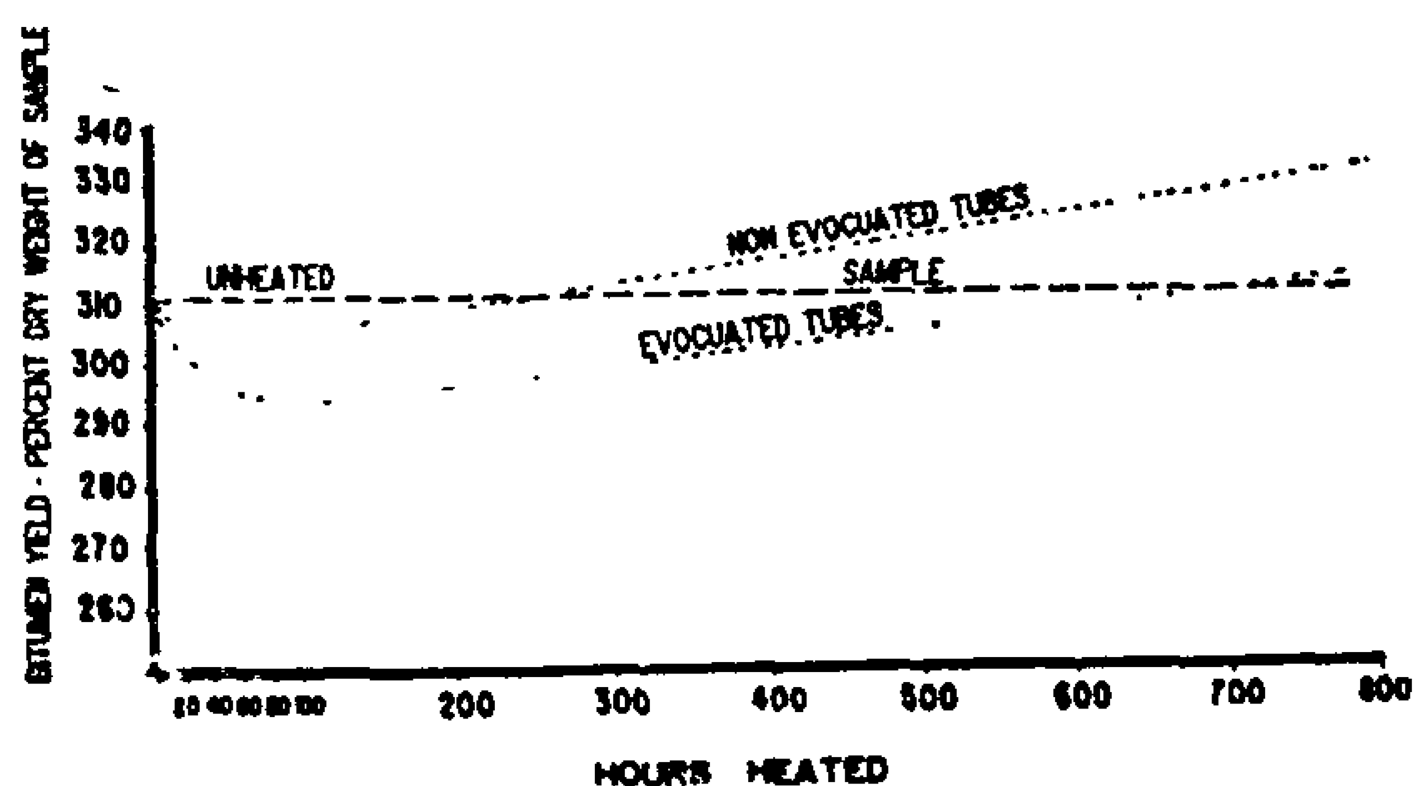


Fig.7a, Bitumen formation at 150°C.

The rate of bitumen formation is noticeably increased at 250°C. and becomes much more rapid at 300°C. Approximately 9 % more bitumen was extractable from shale heated for 60 hours at 250°C. and 67% more from that heated for the same length of time at 300°C. than was recoverable from unheated samples of the same material. These differences correspond respectively to 0.26% and 1.93% of the total dry weight of the shale sample and, obviously, to much larger percentages of the weight of the organic matter in the shale (Figs. 7 a, b and 8).

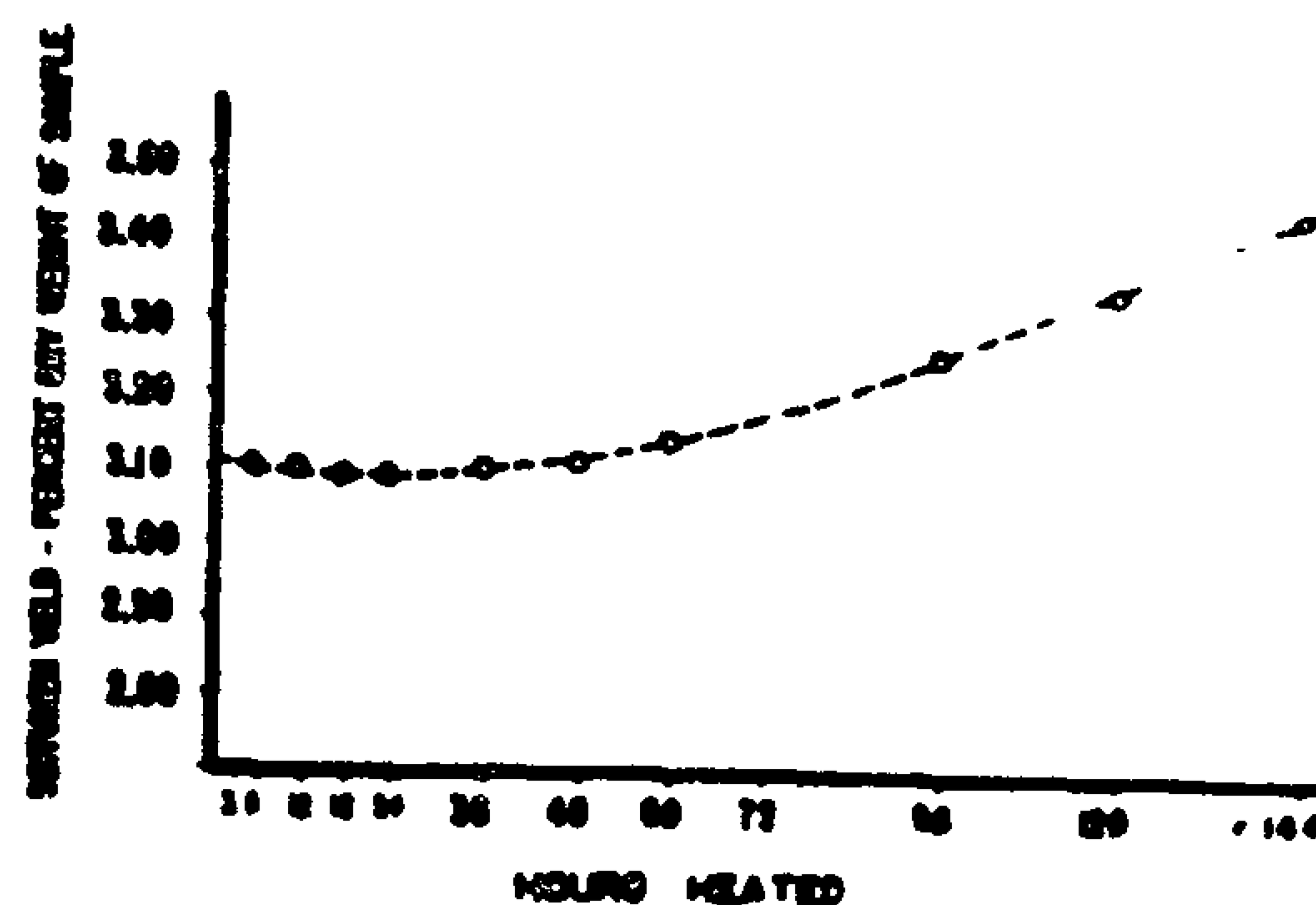


Fig.7b, Bitumen formation at 250°C

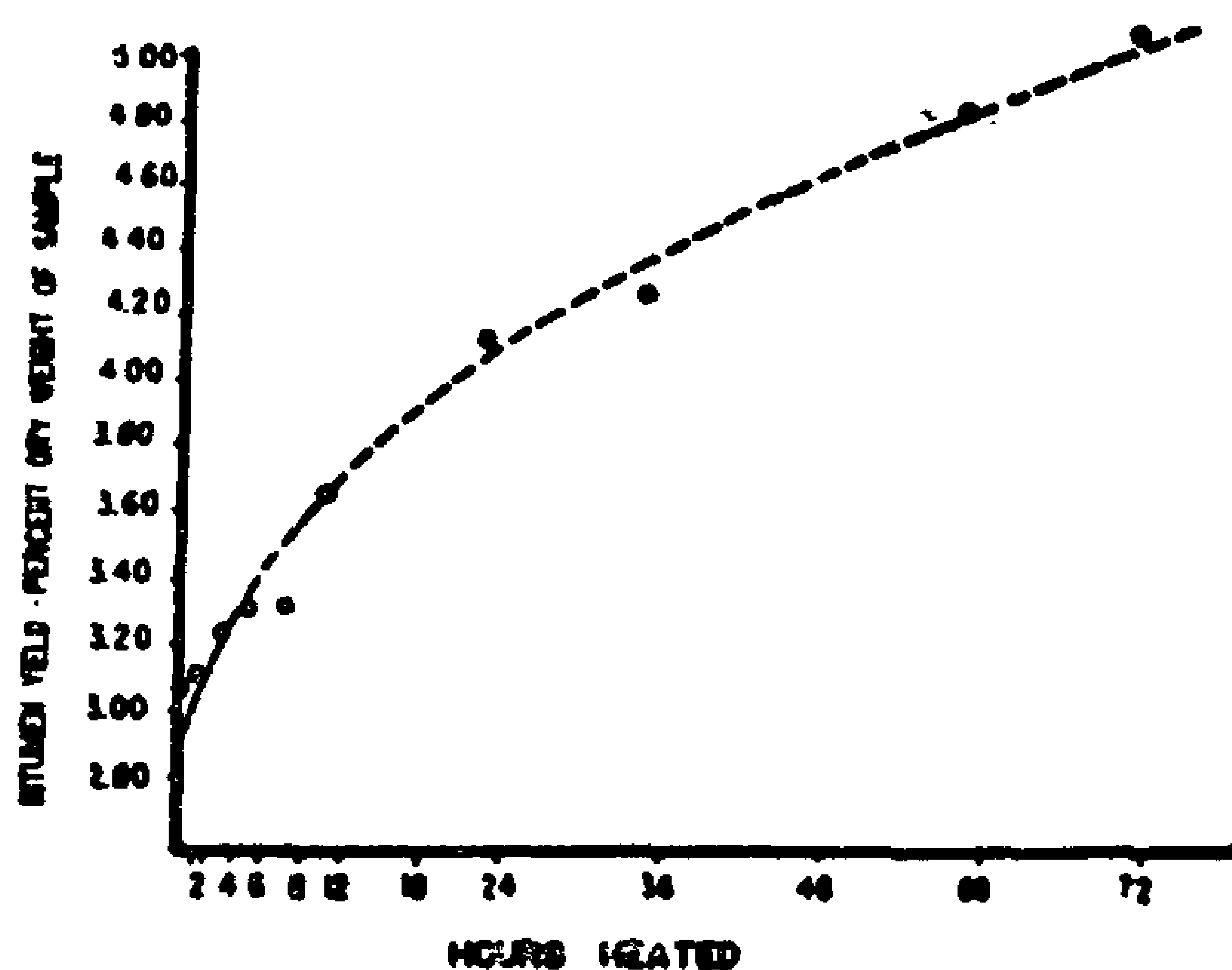


Fig.8 , Bitumen formation at 300°C.

Shale samples heated at a temperature of 350°C., and under similar conditions, show large amounts of insoluble organic matter converted to a soluble form in short periods of time. Approximately 3% of the dry weight of the unheated shale was extractable as chloroform-soluble bitumen, whereas 16.6% of the dry weight of the sample was recovered as extract from the shale heated for 30 hours at a temperature of 350°C. The speed of reaction appears to decline as the period of heating is extended. Large quantities of gas are formed at this temperature with the consequent result that considerable pressures develop within the bombs (Fig. 9).

Eisma and Jurg (1964); Shimoyama and Johns (1971, and 1972); and Almon (1974). Degradation of alc hols (Sakikana, 1951), esters- ketones (Frost, 1940; Demorest et al., 1951), and aldehydes (Levi and Nicholls, 1958) were also studied.

In more recent work, mainly marine muds were used. For instance, Erdman and Mulik (1963) by heating muds, have produced low molecular weight hydrocar bones, that are absent in Recent sediments Ishiwatari et al. (1976) heated kerogen from a young marine sediment collected in the Tanner basin, offshore California. Kerogen produced liquid products and gas comprising initially carbon dioxide and water, then methane, other hydrocarbones and hydrogen. Harrison (1976) studied the evolution of free and bound fatty acids by using pyrolsis of modern sediments.

Numerous experiments of heating ancient sediments, which have previously been subjected to an exhaustive extraction, have shown that kerogen is able to produce new hydrocarbons when heated at a higher temperature than the maximum reached during its burial history.

Secondly, in the course of investigations of Eocene green river shales of Western USA Maier and Zimmerly (1924) observed that the lower the temperature used in the thermal treatment, the longer the time needed to generate a given amount of extractable bitumen in the shale. They employed temperatures in the range from 275°C - 365°C, and the times were up to 144 hours.

Maier and Zimmerly (1924), following their discovery that bitumen formation does not take place at a definite temperature as was formerly supposed, conducted a series of experiments to determine the rate of bitumen formation at temperatures varying from 200° - 365°C.

Measurements of the effects produced were made on the basis of the amount of bitumen that could be extracted from the samples with tetrachloride solvent. A mathematical expression was derived for calculating the rate of bitumen formation at any temperature and for computing the amount of bitumen formed during a given period of heating. The conclusion was reached that "the nature of the transformation shows that it does not begin at any definite temperature" and that "the amount of bitumen formed is independent of the temperature provided that the time of heating is long enough." Trask (1931) has supplied a correction to this conversion formula. He also noted that much smaller quantities of originally soluble bitumen are found in recent sediments than in oil shale of comparable organic content, and that when recent deposits and oil shales are heated in the same manner, the results are similar. According to him, one percent conversion to bitumen requires : 8.4×10^4 years at 100°C, 2×10^6 years at 80°C or 6.7×10^7 years at 60°C.

The Am. Bureau of Mines (U.S. Bur. Mines Bull. 210, 1924; and 249, 1926) in its studies concerned with the retorting of oil shales, found that : As the temperature is raised, the organic matter of the shale decomposes and produces vapours which condence to form shale oil, Simultaneously, fixed gases are evolved. When the organic matter of a typical shale is heated, it changes first to a soluble bitumen and, as the heating continues, this bituminous substance further breaks down or craks and forms shale oil ...... Although most shales apparently begin to give off vapours at 300 to 370°C these same shales will slowly decompose and yield oil at temperatures as low 100°C to 200°C To retort the shales completely at such low temperatures, however, would require many hundreds of years,

1 — Sediments deposited in subaquatic environments contain large amounts of water (60% by weight), minerals, dead organic material, and numerous living microorganisms. Such a mixture is considered to be out of equilibrium and therefore unstable. Diagenetic processes start-under these conditions of shallow burial - and through which the system to approach equilibrium and the sediment normally becomes consolidated. The depth interval concerned is in the order of a few hundered meters, the increase of temperature and pressure is small, and transformations occur under mild conditions. During early diagenesis, one of the main agents of transformation is microbial activity, which destroy the organic material and produces kerogen precursor, methane, and in some cases lignite and sub-bituminous coal (for details refer to Vassoevich et al. 1969, 1974; and Tissot et al. 1978). —

2 Consecutive deposition of sediments results in burial of previous beds to a depth of several kilometers of overburden in subsiding basins. This means a cosiderable increase in temperature (50-150°C) and pressure (300 - 1500 bars). Tectonics may also contribute to this increase. Organic matter experiences major changes; throug progressive evolution the kerogen produces first liquid petroleum; then in a later stage «wet gas» and condensate; both liquid oil and condensate are accompanied by significant amounts of methane. Lignite and sub-bituminous coal, if present, progress through the various ranks of coal, and also produces hydrocarbons, mostly methane. For this stage of evolution, the word Catagenesis is used (Vassoevich, 1957; Strakhov, 1962; and Tissot et al., 1978), and with further evolution there is no more generation of petroleum, but limited amounts of methane.

3 — The last stage of evolution of sediments, which is known as metamorphism, is reached in deep troughs and in geosynclinal zones. Here temperature and pressure reach high values; in addition, rocks are exposed to the influence of magma and hydrothermal effects.

—Petroleum geology, however, is only concerned with the stage precursing metamorphism, which will be referred to as metagensis of organic matter. At this stage the organic matter is composed of methane and a carbon residue. Coals are transformed into anthracite.

THERMAL GENERATION OF PETROLEUM :

The hypothesis of thermal transformation of organic matter to petroleum is based on observations of two main types :

First; coals, lignites, oil sheles, vegetable matter and oil or fats of vegetable and animal origin. these when heated to suitable temperatures undergo decomposition with the production of oily or tarry matter,gases and other substances. Experimental heating of organic matter has been carried out by many authors in order to suport this theory, the experiments are based on different natural substances as well as on artificial ones : substances extracted from living organisms, Recent muds, kerogen from ancient sediments, and pure chemical components.

Warren and Storer (1895), took a fish called menhaden and heated its fatty oils in a sealed container at 320°C. for several hours under a pressure of 15 atmospheer (200 psi), they, then, fractionated the remains; 29.% of the remains distilled over below 150°C, 57.5% of the remains distilled over between 150°C - 300 °C. The remains of stage two were treated with H 2 SO 4 and then neutralized with caustic soda leaving a substance rather like kerosene.

This idea of Warren and Storer was studied by numerous authers, including Bogomolov et al. (1960, 1961, and 1963);

GENERATION OF PETROLEUM

The physicochemical transformation of organic matter during the geological history of sedimentary basins is controlled by the same factors that also determine the variations of composition of the inorganic solid phase and of the interstitial water of the sediments. Three factors (agents) have received extensive consideration with regard to process of oil formation from organc matter:

1 — Bacteria, and is active in an early stage, i.e. soon after deposition of sediments.

2 — Mild thermal metamorphism aided by pressure and time.

3 — Radioactivity; which can occur at different stages of the sediment evolution, however, it is believed to be active at an early stage in the history of the sediments

The following stages of evolution of sediments and contained organic matter have been suggested by Tissot et al. (1978), Fig. (6):

CH : Carbohydrates, AA : animo acids, FA : fluvic acids HA : humic acids, L : lipids, CH : hydrocarbons, N, S, O N, S, O compiunds (non-hydrocarbons).

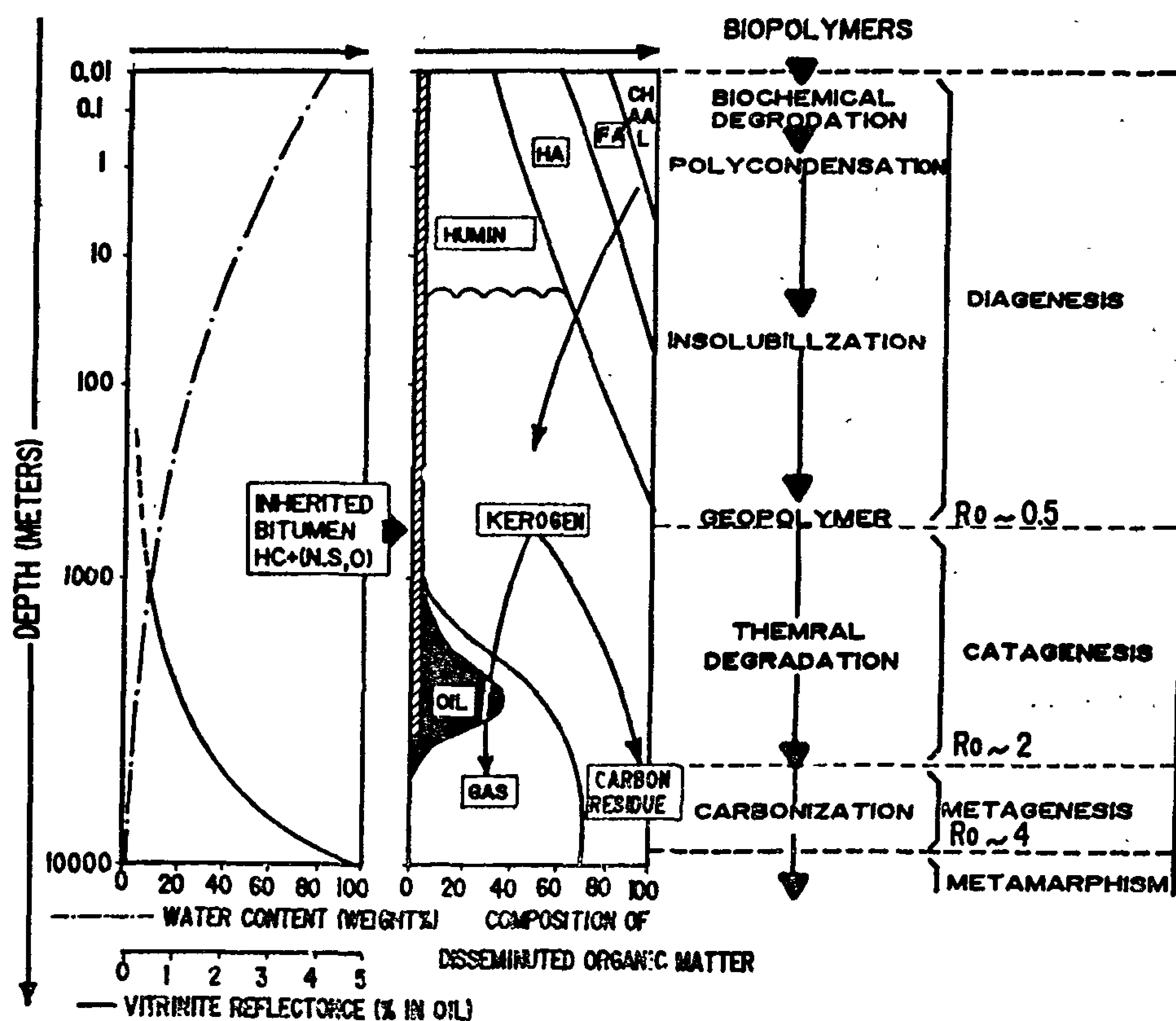


Fig. 6, General acheme of evolution of oragnic matter, from the freshly deposited sediments to the metamorphic zones. (After Tissot et al., 1978).

Recent studies of oil classification by source input have relied heavily on waxiness as an environmental source input parameter (e.g., Connan and Cassou, 1980; Sofer, 1984). The standard method of organic material in an oil is to determine organic material in an oil is to termine its degree of waxiness. This method assumes that terrigenous material contributes a high molecular-weight normal paraffin component to the oil (Hedberg, 1968; Albrecht and Ourisson, 1971), also see figure (5) which illustrates high-wax crude oils derived from continental organic matter. Marine organic matter, both animal and vegetable, leads to non-waxy oils; and that whether oil or gas is formed depends on the diagenetic history of the organic matter, with temperature as an important factor.

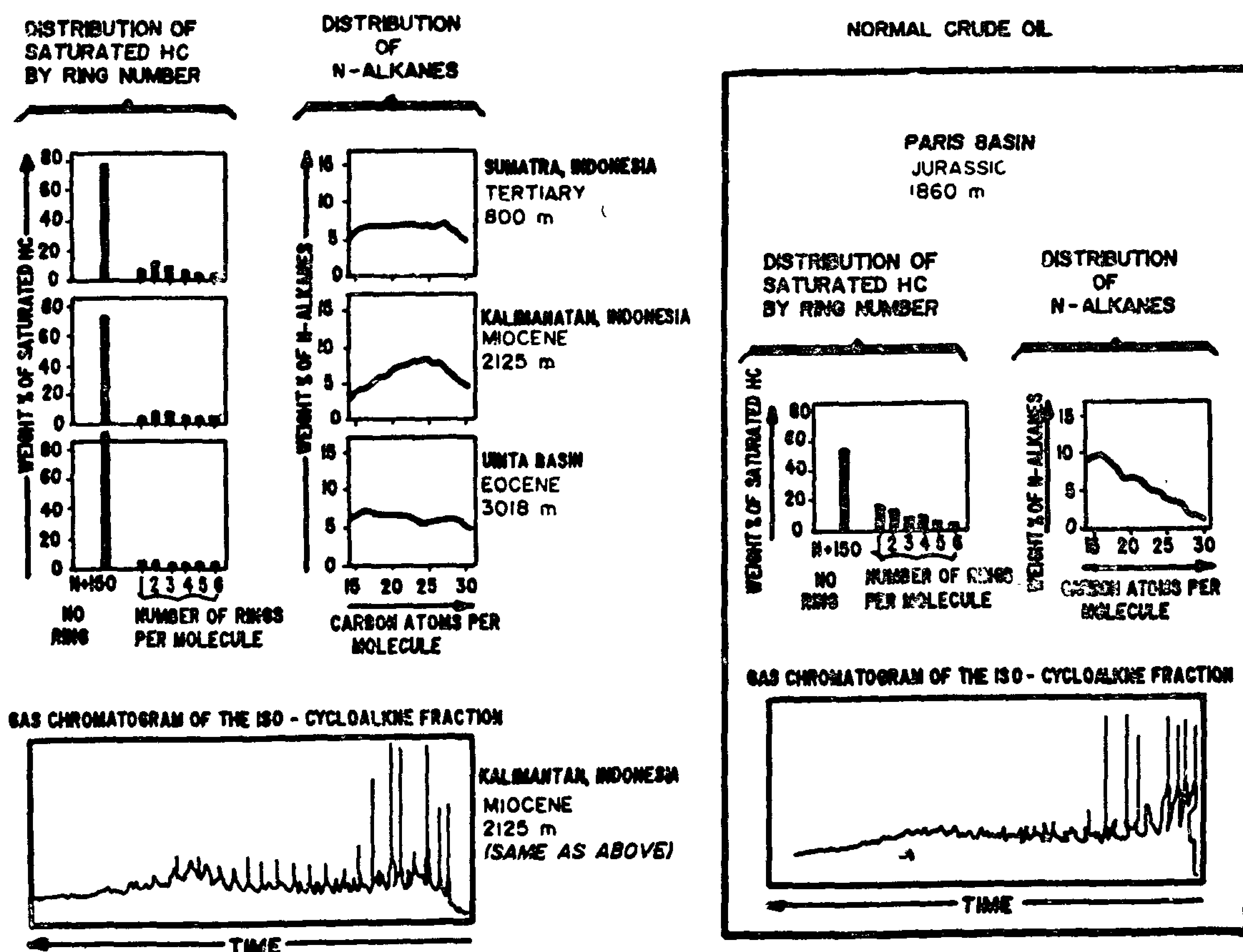


Fig. 5 Examples of high-wax crude oilsprobably derived from continental organic matter extensively reworked by mi-croorganisms. High molecular weight n-alkanes are abundant, but they do notshow a marked odd or even predominance. Note the homologous series of 2-methyl lalkanes indenfied by solid circles on the gas chromatogram of the iso-cycloalk-ane fraction (bottom). A normal crude oil from Paris Basin is shown for com-parison.

ORIGIN	TYPE OF SEDIMENT	NUMBER OF SAMPLES	EXTRACTABLE BITUMEN (PPM)		ORGANIC CARBON	AVERAGE HC / AVERAGE ORG C (MG / G)	AUTHOR
			HC	NON HC	(%)		
SOILS (TEXAS)	CONTINENTAL	-	60	-	1.2	5	PHILIPPI (1965)
PEATS (FLORIDA)		-	350	-	37.0	0.9	PHILIPPI (1965)
FRESHWATER LAKE (LAUISIANA)		-	41		0.3	14	PHILIPPI (1965)
MUD FLAT (SABINE PASS, TEXAS)	COASTAL	-	23	-	0.9	3	PHILIPPI (1965)
LAGUNA MADRE, TEXAS		-	20	-	0.4	5	PHILIPPI (1965)
LOUISIANA		2	30	735	-	-	SMITH (1954)
CAHFORNIA (ESTUARY POND)		1	800	6800	-	-	SMITH (1954)
LAKE MARACABIO		8	68	1060	2.2	3	HUNT (1961)
MISSISSIPPI	DELTAIC	-	80	-	1.2	7	PHILIPPI (1965)
MISSISSIPPI		-	80	-	0.8	10	PHILIPPI (1965)
MISSISSIPPI		4	65	860	-	-	SMITH (1954)
LOUISIANA		-	20	-	0.8	2	PHILIPPI (1965)
PELICAN IS (0-100 ft)		3	38	210	0 5	8	SMITH (1954)
ORINOCO		3	55	709	4.9	1	SMITH (1954)
ORINOCO		10	60	555	0 9	7	HUNT (1961)
GRANDE ILE (18-53 ft)	OPEN MARINE	-	6.5	255	-	-	SMITH (1954)
GULF OF MEXICO		10	32	275	0 5	6	HUNT (1961)
GULF OF MEXICO		-	30	-	0 9	3	PHILIPPI (1965)
MEDITERRANEAN SEA		1	29	461	0.7	4	HUMT (1961)
CUBA	CARBONATE MUDS	10	40	575	1.4	3	HUNT (1961)
FLORIDA			20	-	1 2	2	PHILIPPI (1965)
DSDP (VARIOUS LOCATIONS)	DEEP MARINE	-	10-40		0.1-0.3		HUNT (1972)
CHUDASCO TENCH			23	-	1.7	1	PHILIPPI (1965)
OH W. AFRICA		4	31	376	1.5	2	SMITH (1954)
CARIACO TRENCH		16	105	1250	2.0	5	HUNT (1961)
CARIACO TRENCH		-	140	-	3.4	4	PHILIPPI (1965)
OFF CATIFORNIA		-	100	-	2.1	5	PHILIPPI (1965)

Table 1 Average values of hydrocarbons, non-hydrocarbon bitumen, and organic carbon in Recent sediments

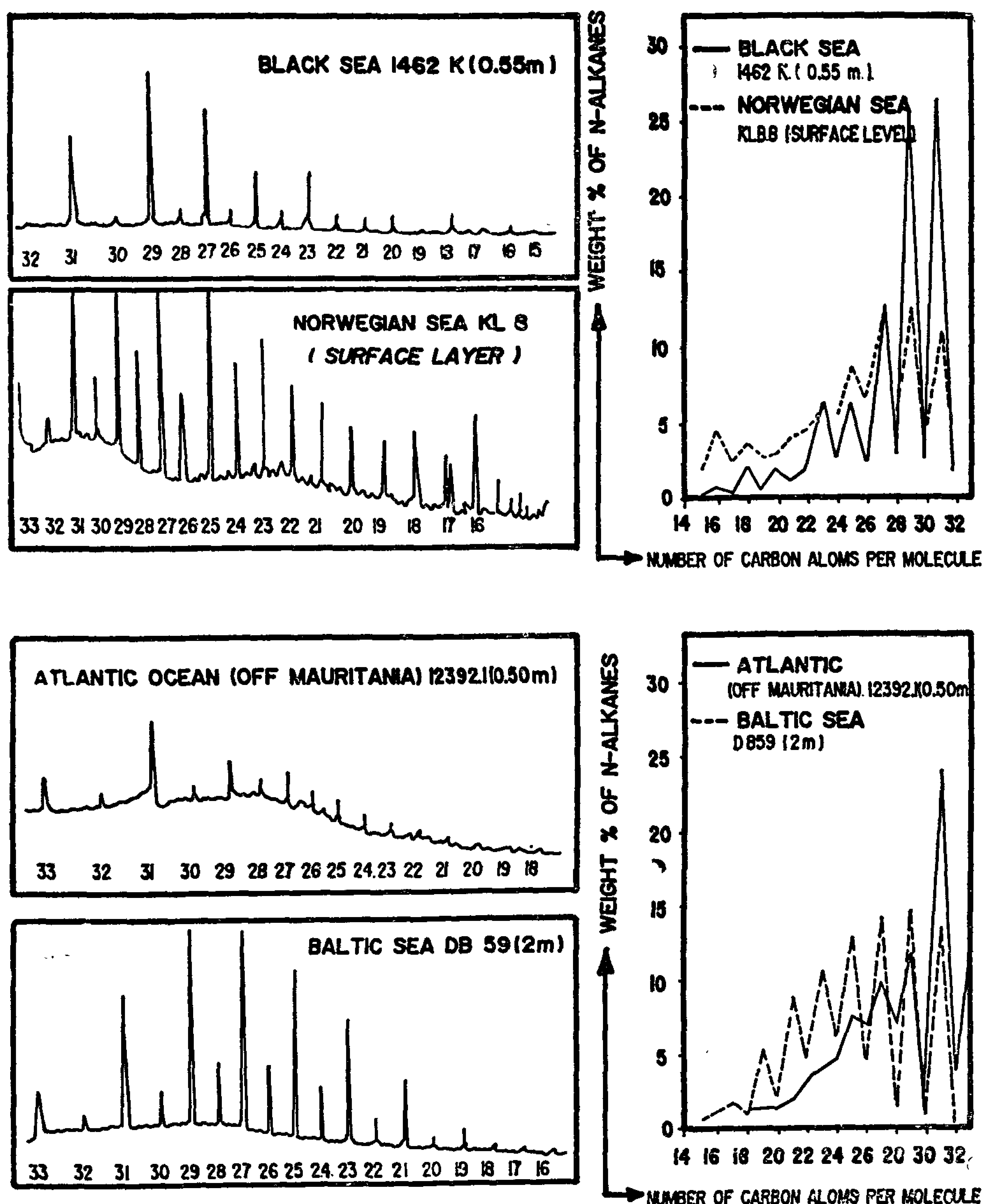


Fig. 4 Distribution of n-alkanes in Recent sediments of origin. Gas chromatograms of saturated hydrocarbons (left) showing the peaks of n-alkanes, with their carbon numbers. n-Alkane distribution curves derived from gas chromatograms (right). (After Dastillung, 1976; Debyser et al., 1977).

Volkman et al, (1983); studied different oils from Australia and gave evidence in support of a source input variation between these oils. He suggested incorporation of varying amounts of nonmarine organic matter into the marine sediments. J. Michael Moldowan et al, (1985); also studies the relationship between petroleum composition and depositional environment of source rocks. His study addresses the question of general applicability of certain geochemical parameters to relate crude oil composition with source rock origins - marine or nonmarine.

which, before or during migration, becomes modified by the chemical and physical environment, particularly by increasing temperature during burial until it eventually becomes petroleum. The origin of the organic material in sedimentary rocks and crude oil has received much attention by many investigators, e.g. Trask et al (1942); Hunt (1962); Hanson (1960); Bray et al (1961); Tissot and Welte (1978); Bemaison and Moore (1983).

Trask and his co-workers (1942) have published information on the amounts of organic matter in sediments. According to them, the organic matter content of recent sediments ranges from 0.3% up to 7.0% with an average value of 2.5%. Some black sea deposits contained as much as 35% of organic matter. Figures (1 to 4) Table (1) illustrate and the occurrence and distribution of organic matter and various hydrocarbons in sediments.

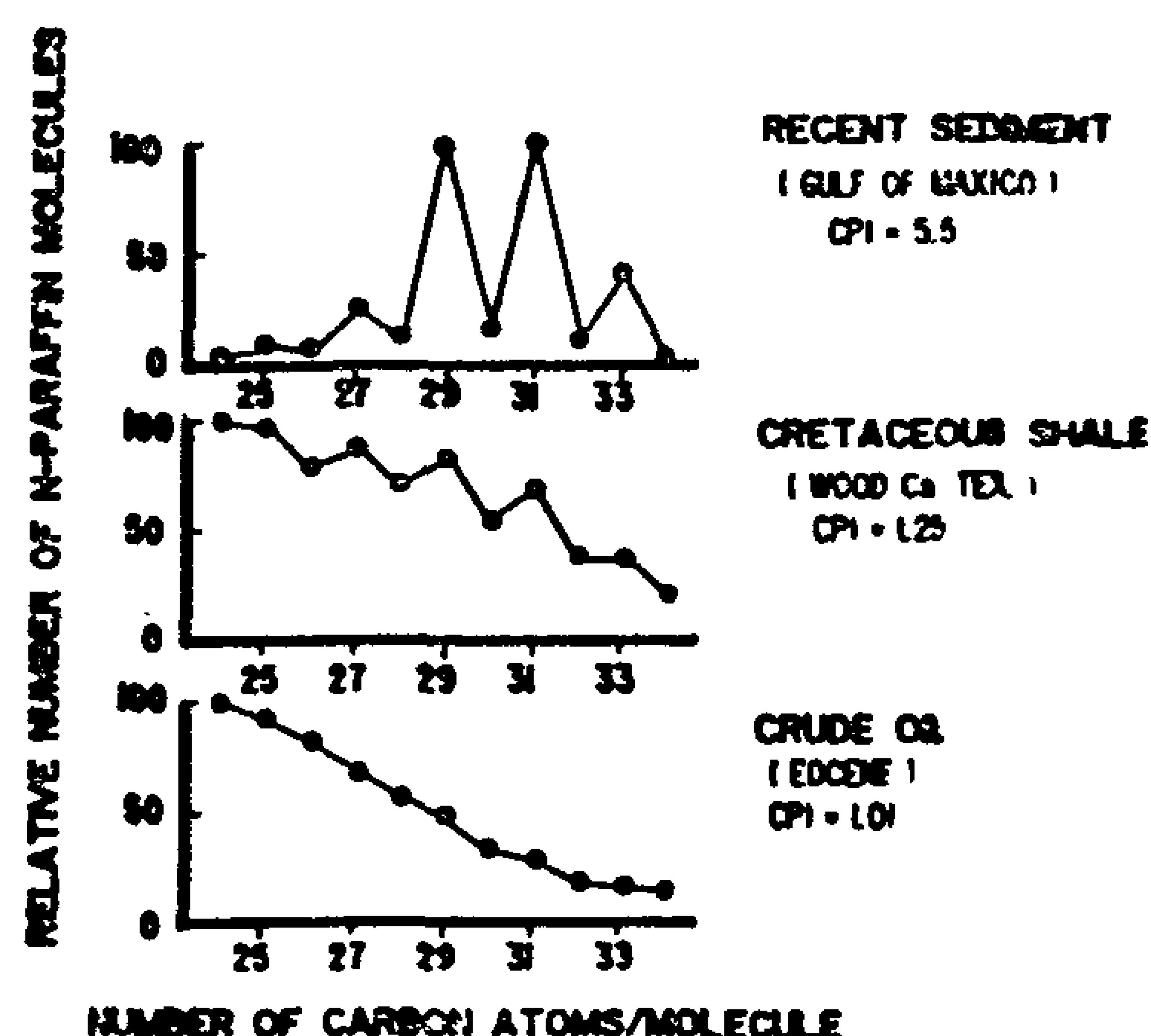


Fig. 1 Examples of n-paraffin distributions in sediments and crude oils. (after Bray and Evans, 1965)

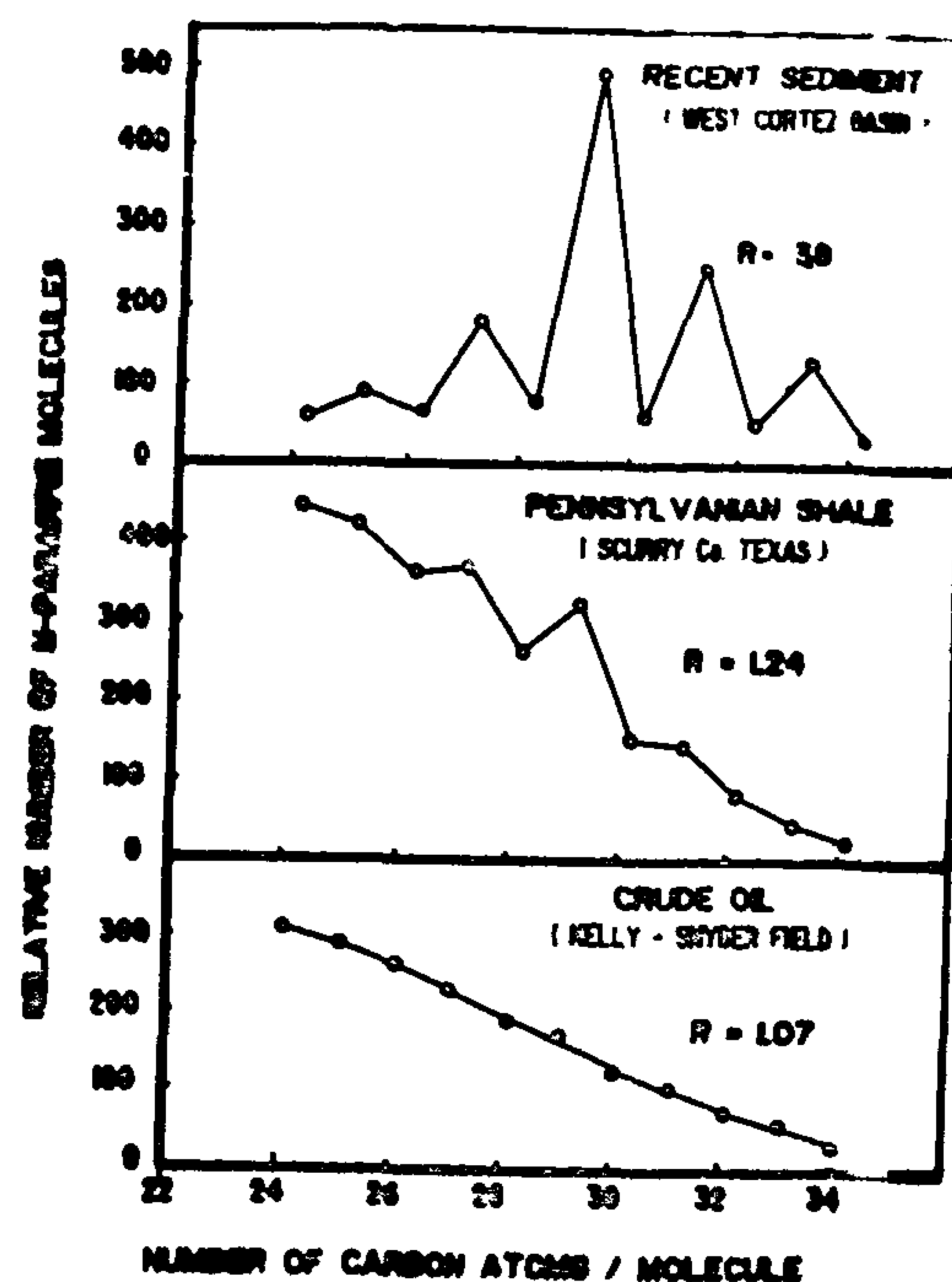


Fig. 2 n-paraffin distribution for a recent sediment, a Pennsylvanian marine shale, and a Pennsyl-vanian crude oil; r=odd-to even-carbon-number ratio (after Bray and Evans, 1961)

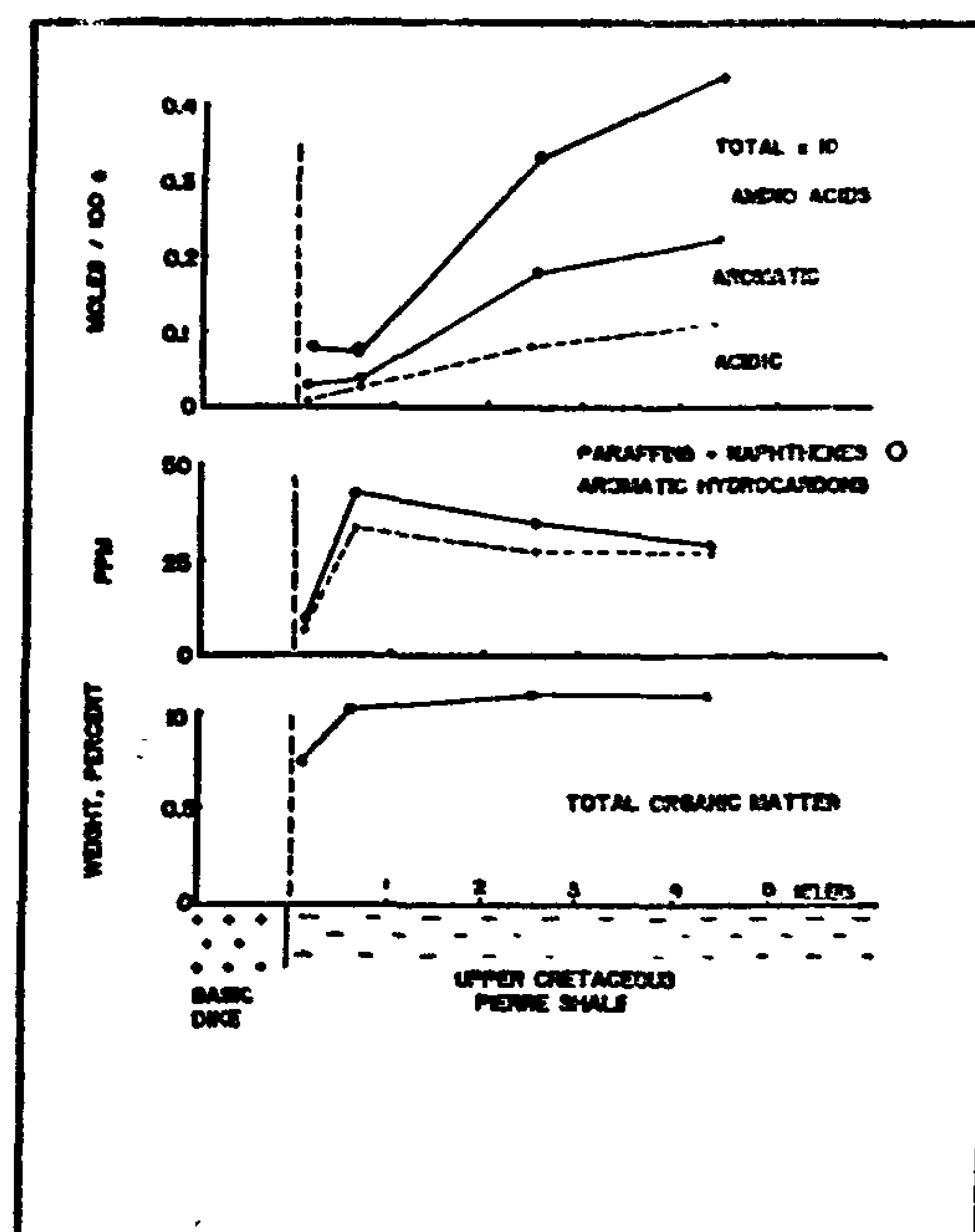


Fig. 3 Distribution of various hydrocarbons and amino acids in the wall rock of a basic dike; Upper Cretaceous Pierre Shale (after Hunt, 1962)

cal characteristics of petroleum, however, changes in chemical composition have been observed, which may be attributed to either the environment of deposition or to depth of burial.

(8) No consistent differences have been observed between oils that are known to have been migrated and those that are formed where they are now been found. Any valid theory of origin of petroleum, therefore, must be independent of oil migration effects.

(9) The highest ratio of oil pool occurrence to volume of sediments occurs in the Pliocene series, which ended about one million years ago. This suggests that the required time for formation and accumulation into pools is probably less than one million years.

These conditions still appear substantially correct, but some of them have been shifted as follows;

— Marine environment seems responsible for most petroleums but many major occurrences appear to be definitely nonmarine in origin.

— Biogenic origin still seems valid for almost all petroleums but there are strong suggestions that some traces of petroleum-like hydrocarbons may be of abiogenic origin.

— Petroleum reservoir temperatures as high as aboutt 170°C have now been recorded and the presence of chlorophylls has now been raised to at least 300°C (Hedberg, 1964). However, it seems probable that relatively few commercial oils have ever been exposed to temperatures as high as 120°C. and that, if early genesis is postulated, most petroleums originated at temperatures far below 100°C.

From the above discussion it seems that the details for one petroleum may be quite different than for another and the origin of any specific petroleum as it exists today may have been a very complex process involving the interplay of many different factors at different times. Many kinds of organic matter, in many different environments, through many different processes, may at some time or at some place have resulted in material which can be classed as petroleum. Most petroleum was probably derived from animals, some from plants; some was marine, some non-marine; some from limestones, some came from shales, some resulted from high temperatures, some not; some may have migrated far, some originated where they are now been found; and so on.

Many different hypotheses, of petroleum origin, have been advanced and some of these may have validity for specific cases-or a combination of them may have been active. Thus, there is no justification to assume that all petroleums, or even all constituents of petroleums, originated in the same way.

SOURCES OF PETROLEUM: (Organic Source)

There is a general agreement that the main source of petroleum is organic matter, buried with a fine grained sediments, usually clay, and that diagenesis of this organic matter leads to a prtopetroleum»

RELATIONSHIP BETWEEN HEAT, DEPTH, AND OIL GENERATION

Mohamed A. Abou Saif, Hamid M. Khattab, Shouhdi E. Shalaby

INTRODUCTION

Since the accumulation of oil and gas have a direct bearing on origin, thus, the origin of petroleum will be discussed first.

Cox (1946) in his study concerning the process of transformation of organic matter into petroleum mentioned that hydrocarbon compounds similar to those found in petroleum may be formed in the laboratory from various source materials. However, any laboratory results proposed will be applied within a set of conditions that can reasonably be compared to the known field conditions. Some of these conditions - The Geological Fence - are summarized as follows :

(1) Nearly all petroleums occur in marine sediments, consequently the contained petroleums are also marine, or related to marine conditions.

(2) Although no two petroleums are exactly alike chemically, and each petroleum is a distinct and extremely complex mixture of organic compounds, still the over-all elemental composition of most petroleums is remarkably consistent, falling within a range of 11 - 15 % by weight hydrogen and 82 - 87% carbon (Landes, 1959). Moreover according to Rossini (1958), all petroleums contain substantially the same hydrocarbon compounds. Variations in properties from one oil to another are probably due to variations in the primary source materials different environments, migration, catalysis, polymerization, pressure and temperature changes, and metamorphism, see e.g. Hedberg et al, (1947), Hunt (1953), E.G. Baker (1959), Krejci-Graf (1963), Goodwin (1973), Patterson (1974), Paoletti et al. (1974), Dicson et al. (1979), and Faaorusso (1980).

(3) Petroleum is found from Precambrian to Pleistocene. These occurrences show that petroleum, once formed, may have been preserved against destruction and decay over long periods of geologic time.

(5) Since the temperature of petroleum reservoirs rarely exceed 225°F (100°C), this suggests that the origin of petroleum is a low temperature phenomenon; Levorsen (1967).

(6) The presence of some chlorophyll derivatives such as porphyrin, which is easily and rapidly oxidized and decomposed in aerobic conditions and also, the low oxygen content of petroleums indicate that the origin of petroleum is within an anaerobic and reducing environment.

(7) The fluctuations in pressure and temperature within a petroleum reservoir show no appreciable change in the physi-

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APPENDEX

The drag coefficient A comes from the general relationship [12] :

$$A = \tau_c b/v_c \qquad (A1)$$

where τc is the shear stress ffor a dislocation to breakaway from its solute atmosphere and vc is the velocity of dislocation at stress just below τc.

The critical stress τc for Cottrell-Jaswon mechanism in dilute solid solutions is in the order of [17].

$$\tau_c = (17\ X_B \beta)/V_A b \qquad (A2)$$

where

$$\beta = (Gb/3\pi)\left[(1+\nu)/(1-\nu)\right](V_B - V_A) \qquad (A3)$$

and VB, VA, are the atomic volume of solute and solvent atoms, respectively and is Poisson's ratio (113).

The critical velocity v is given by [17].

$$v_c = 4\ D_g kT/\beta \qquad (A4)$$

From equation (A1) to (A4), the drag constant ACJ for Cottrell-Jaswon mechanism in a dilute solid solution is

$$A_{CJ} = X_A X_B e^2 G^2 b^5 / D_g kT \qquad (A5)$$

where e is the atomic misfit parameter $[=(V_B - V_A)/3\ V_A]$ and

$$V_A = 0.7\ b^3.$$

For a concentrated solid solution the critical stress must increase with increasing XB (and decreasing XA = 1 - XB) up to 50 - 50 concentration and then decrease with decreasing XA (increasing XB = 1 - XA). Thus a reasonable appoximation for τc for concentrated solid solution is [16].

$$\tau_c = (17\ X_A\ X_B\ \beta)/V_A b \qquad (A6)$$

and for A_{CJ} is

$$A_{CJ} = (X_B\ e^2 G^2 b^5)/D_g kT \qquad (A7)$$

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ute concentration and atomic misfit parameter. This formulation is not consistent with the creep data of the alloys shown in Fig. 3.

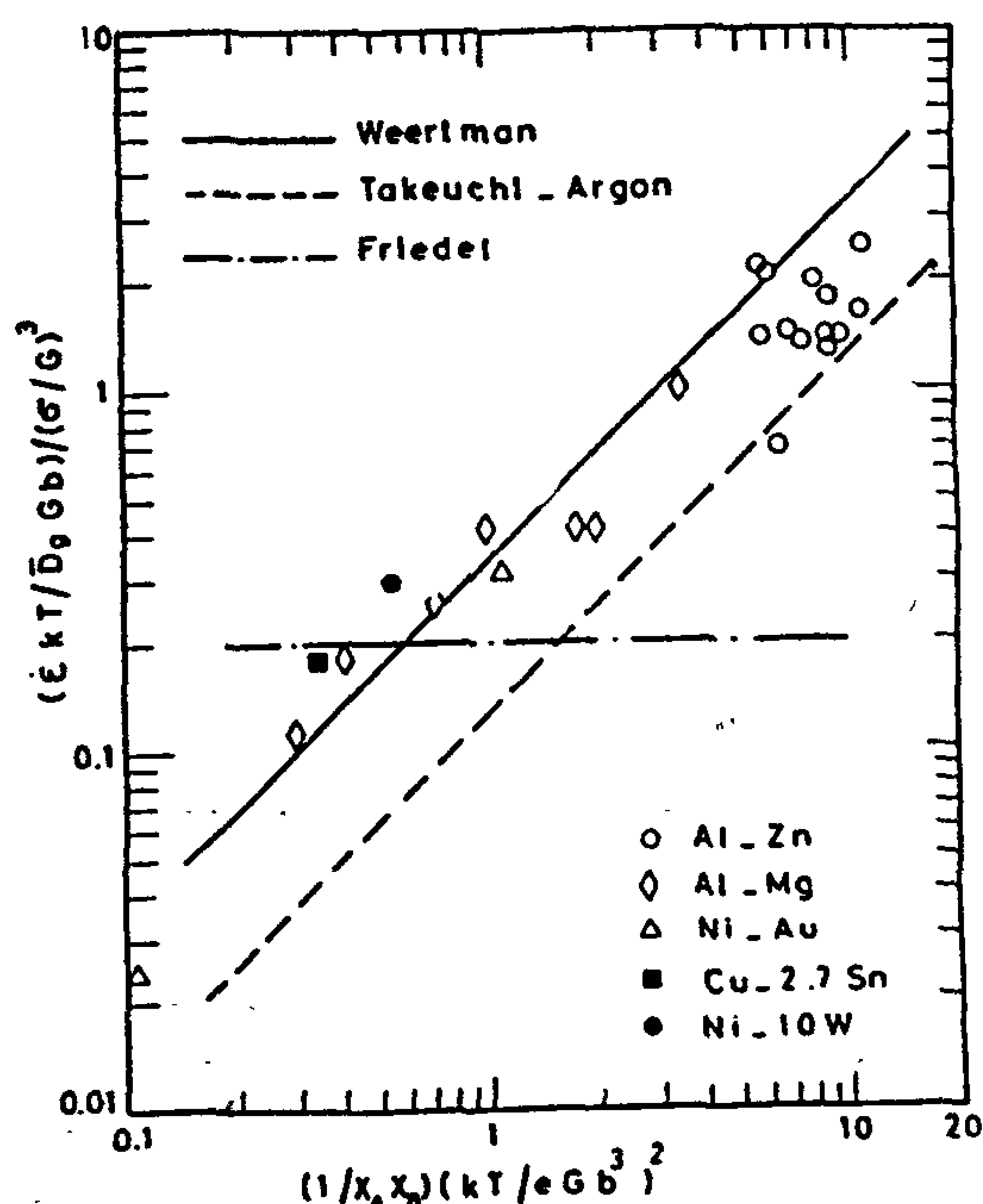


Fig. 3 Correlation between the creep behavior of Al-Zn alloys and tsree viscous glide models.

Recently a dislocation loop model has been been formulated by Mills et al [28] to exlpain the creep data of Al-5.5 a/o Mg (class I alloy). Although this model can exipain some asepcts of the creep data of Al-5.5 a/o Mg alloy, it results in a steady state creep rate of a factor 15 below the prediction of weerthman model (Eq. 15). Burton [29] has recently extended his dislocation network model, developed to exlpain creep in pure metals, to include the effect of solute atmosphere drag on alloy behavior. It was shown that the criterion for the onset of solute-drag limited creep (class I) is Mc/Mg $\geq$ 1, or

$$.10(X_B \psi^2)\ (\bar{D}_c/\bar{D}_g)\ \left\{\frac{Gb^3}{3\pi\ kT}\ \left(\frac{1+\nu}{1-\nu}\right)\right\}^2 > 1$$

where Mc and Mg are the glide and climb mobility, respectively, Dc is the climb diffusion coefficient [8], V is Poisson's ratio and μ= (VB - VA) / VA, where V is the atomic volume. A condition of similar form as Eq. 17 has been derived earlier by Takeuchi and Argon [26]. Substituting typical values for Al-20 a/o Zn alloy at T = 633 K : μ = 0.03 [22], $D_c/D_g \sim 8$, μ = 0.33 and G = 1.8x10⁴ MPa, the left hand side of Eq. yields a value of 1.5 which satisfies tne condition (Eq. 17). However, this condition is far from complete since it does not include the effect of stress level and the stacking fault energy [4, 15, 25].

CONCLUSION

1. The activation energies based on the new diffusion coefficient proposed by Fuentes-Samanigo et al, for describing viscous glid-controlled creep, agree well with the experimental ones for creep in the class I Al-Zn alloys.
2. The predictions of viscous glide models based on Cottrell-Jaswon interaction are in good agreement with the creep data for the class I Al-Zn alloys.

ACKNOWLEDGEMENT

This work was supported by the Research Center, College of Engineering, King Saud University. Thanks are due to Eng. I. El-Galali for his assistance and to Mr. A. Choudhry for typing the manufacscript.

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I alloys would seem appropriate due to the viscous nature of dislocation motion in this creep regime. The velocity is determined by the applied stress through the relation (v = σ b/2A) [13] where A is drag coefficient which can be determined for the particular solue/dislocation interaction that is controlling the viscous glide. Substituting ρm = (σ /Gb)^2 [2], the creep rate is given by

$$\dot{\varepsilon} = (1/3)\ (G/A)\ (\sigma/G)^3 \quad (11)$$

This equation is exactly similar to the one obtained by Weertman [13] from a detailed model of the dislocation geometry. Five processes are listed [14] as possible drag mechanisms (microcreep mechanisms) which effectively act in series and the resulted creep rate [15, 16].

$$(1/\dot{\varepsilon}) = (1/\dot{\varepsilon}_1) + (1/\dot{\varepsilon}_2) + \ldots\ldots\ldots$$

or

$$(1/\dot{\varepsilon}) = (3/G)(\sigma/G)^{-3}\ [A_1 + A_2 +] \quad (13)$$

For an alloy in which the five drag mechanisms [15,16] are active the creep rate is given by

$$\dot{\varepsilon} = (1/3)\ G(\sigma/G)^3\ [A_{CJ} + A_F + A_{Su} + A_S + A_{APB}]^{-1} \quad (14)$$

where ACJ, AF, ASU, AS and AAPB are the drag coefficients of the Cottrell-Jaswon mechanism [17], the Fisher mechanism [18], the Suzuki mechanism [19], the stress-induced order mechanism [20] and the antiphase boundary mechanism [14]. The contribution, importance and the values of the drag coefficients of these mechanisms are discussed in detail elsewhere [15,16,21]. It is demonstrated [15] in most alloys systems that the drag force acting on moving dislocations is resulted mainly from Cottrell-Jaswon interaction [17], although the effect of Fisher and Suzuki interactions [18,19] can not be neglected in some cases [10,15]. When Cottrell.Jaswon in rate controlling, Eq. 14 can be written for concentrated alloys as (see appendex)

$$\dot{\varepsilon} = (1/3)(kT\ \bar{D}_g/X_A X_B\ e^2\ Gb^5)(\sigma/G)^3 \quad (15)$$

where e is the atomic misfit parameter, see King [22] and for dilute alloys X 1

1. The effect of solvent concentration in concentrated alloys was not considered previosly [23]. Eq. (15) can be written in a normalized form

$$(\dot{\varepsilon}\ kT/\bar{D}_g Gb) = (1/3)(1/X_A X_B)(kT/eGb^3)^2\ (\sigma/G)^3 \quad (16)$$

To compare the prediction of Eq. 16, with the creep data of the AI-Zn alloys, the parameters

$$(\dot{\varepsilon}kT/\bar{D}_g Gb)/(\sigma/G)^3$$

and

$$(1/X_A X_B)\ (kT/eGb^3)^2$$

are plotted logarithmically in Fig. 3. Besides the data of AI-Zn alloys [9,10] which were calculated at 633 K (Fig. 2) and 683 K, the data of AI-Mg [23], Au-Ni [21] and Cu 2.7 a/o Sn [23,25] are also include for the purpose of comparison. The prediction of Eq. 16 is shown in fig. 3 as a solid line. Also, included in the figure the prediction of a model developed by Takeuchi and Argon [2.6]. In this model the drag force, as in Weerman model [13,14], is due to the Cottrell-Jaswon mechanism [17]. Although, the details of dislocation distribution in both models are different, the prediction of Takeuchi and Argon model is only a factor of 3 slower than that given by weertman model. As in Fig. 3, good agreement is obtained between the creep data of the alloys and the prediction of the viscous glide models based on Cottrell-Jaswon process [17]. The dislocation core-drag model developed by Friedel [27] and later elaborated upon by Bird et al [2] and Mchamed [23], shows that the creep rate is independent of sol-

To calculate Q and Q_g, the tracer diffusion data of the Al-Zn system [11,12] are used. The tracer diffusion data of Al [12] in the range of 0 to 20 a/o Zn were ex-extrapolated to find D*Al in Al-Zn alloys with higer Zn content. In addition, values were estimated at T = 683 K from the equation

$$Q_m = RT\ (1-m)/m \qquad (8)$$

since the excess entropy of mixing for Al-Zn system is approximately equal to zero [11].

The values of Q and Q_g along with the experimental values of the activation energy for creep, Qcreep for Al-Zn alloys [9,10] are shown in Fig. 1. As shown in the figure the values of Qg are higher than those of Q and Qg values are in close agreement with the experimental values of Qcreep. Having established that Dg can explain the activation energy for creep, Dg rather than D will be used in Eq. (1) to normalize the creep data of the Al-Zn alloys.

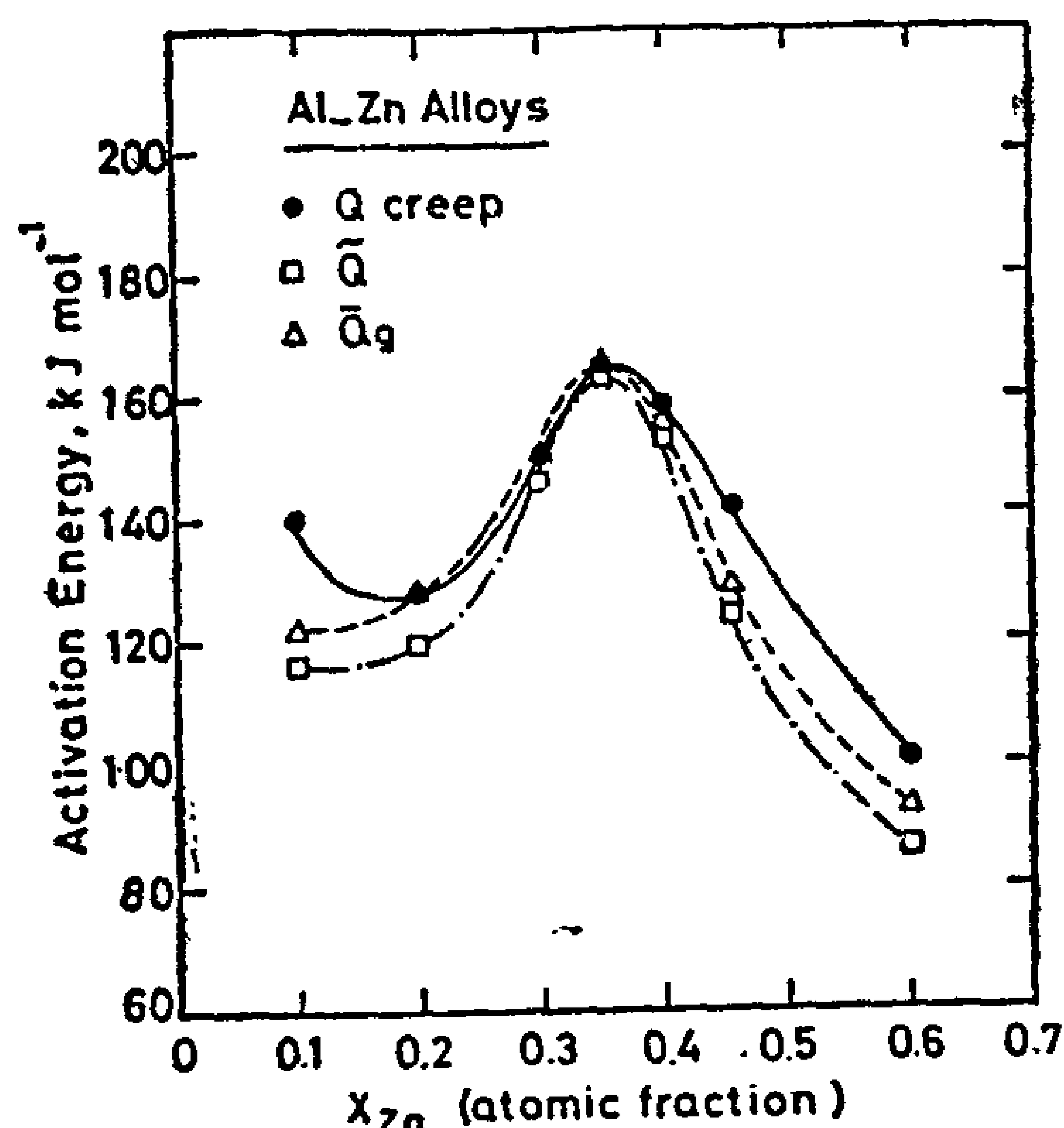


Fig. 1 Activation energy for creep and for glide diffusion coefficients in Al-Zn alloys.

Normalized Creep Rates

The normalized creep rate ($\dot{\varepsilon}$ kT/D_g Gb) is plotted vs. the normalized stress (σ /G) in a double logarithmic scale in Fig. 2 for Al-10 a/o zn [10] and for the alloys containing 20, 30, 40, 46 and 60 a/o Zn [9]. In normalizing the creep data the values of b and G (G $\sim$ 0.4 E; E is the elastic modulus) are taken from the data of Chin [9]; the values of G at 633 K can be represented by an equation of the form :

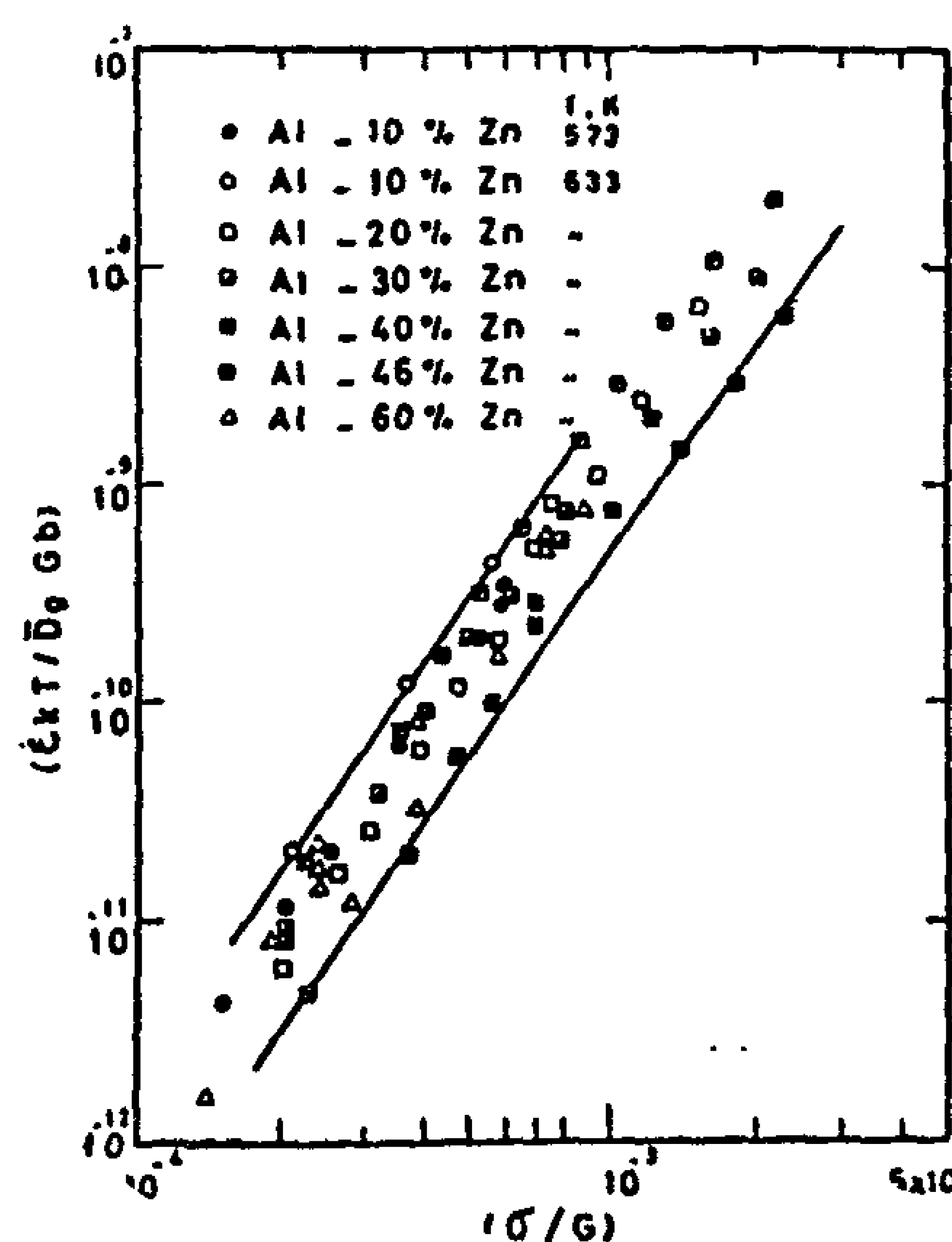


Fig. 2 Normalized creep rate (KT/Dg Gb) vs normalized stress (o/G) for Al-Zn alloys.

$$G = (G_o - \Delta G\ X_{zn}) \qquad (9)$$

where Go = 2x10⁴ MPa is the shear modulus of Al at 633 K and ΔG = 10⁴ MPa and X_{zn} is the atomic fraction for Zn. As shown in Fig. 2 the data points for the alloys fall on straight lines with the same slope of $\sim$3. The constant A' in Eq. 1 has values which lie in the range of 2.7 (for Al-10 a/o Zn) to 0.7 (for Al-46 a/o Zn)

Comparison With Viscous Glide Models

The rate of plastic flows of a creeping solid can be fundamentally described by the Orowan equation

$$\dot{\varepsilon} = (2/3)\ \rho_m\ b\ v \qquad (10)$$

where ρ m and v are the mobile dislocation density and average velocity, respectively. The use of this equation with class

Table 1. Solid solution alloys

Property	Class I (alloy type)	Class II (metal type)
Mechanism	viscous glide	dislocation climb
Stress exponent, n	3	5
Primary creep	little or inverted	large
Dislocation density, ρ	$\rho \alpha \sigma^2$	$\rho \alpha \sigma^2$
Subgrain size, δ	no subgrains	$(\delta/b) \alpha (\sigma/G)^{-1}$
Stacking fault Energy, Γ	no effect	$\dot{\varepsilon} \alpha (\Gamma/Gb)^3$
Examples	Au-Ni, β-brass Al-Mg, Al-Zn(Zn > 10%)	Ni-Cu, α-brass Fe-Si, Al-Zn(Zn < 5%)

Recently, Fuentes-Samaniego et al[7,8] criticized the use of Darken diffusivity for describing viscous glide-controlled creep on the ground that the condition of

$\mu_v = 0$, where μ_v is the vacancy chemical potential, cannot be satisfied in a microscope system involving the movement of a single dislocation. Instead, Fuentes-Samaniego et al at [7,8] proposed the following coefficient as more appropriate for describing viscous glide-controlled creep :

$$D_g = \bar{D}_g = m\,(D_A^* D_B^*)/(X_A D_A^* + X_B D_B^*)$$

The discussion of diffusion coefficients appropriate for describing dislocation climb-controlled creep is beyond the scope of the present paper and was considered in detail elswhere [8].

The concentrated alloys of the Al-Zn system with Zn content > 10 atomic percent (a/o) have n close to 3 and represent a typical example for class I alloys [9,10]. In this paper the activation energies based on D (Eq. 2) and D_g (Eq. 3) are calculated and compared to the creep values for these alloys.

Based on this comparison it will be shown that Eq. 3 is more appropriate for describing the diffusivity. Consequently, D_g is used in lieu of D for normalizing the creep data of Al-Zn alloys and finally the normalized creep rates are compared with prediction of various viscous glide models.

ANALYSIS AND DISCUSSION

Activation Energy

The glide diffusivity is usually defined as

$$D_g = D_{og} \exp(-Q_g/RT)$$

where the activation energy for viscous glide-controlled creep, Qg is given by

$$Q_g = -\partial \ln D_g / \partial (1/RT) \qquad (5)$$

Subsequently,taking the natural logarithm of Eq. (2) and differentiating with respect to 1/T gives

$$Q_g = \tilde{Q} = [(Q_B^* + PQ_A^*)/(1 + P)] + Q_m \qquad (6)$$

where $P = (X_B D_A^* / X_A D_B^*)$, Q_A^* and Q_B^* are the activation energies for the traccer diffusivities of A and B, respectively, and $Qm = -\partial \ln m / \partial (1/RT)$. Similarly from Eq. (3)

$$Q_g = \bar{Q}_g = [(Q_B^* + qQ_A^*)/(1 + q)] + Q_m$$

where $q = (X_B D_B^* / X_A D_A^*)$

RE-INVESTIGATION OF THE CREEP BEHAVIOR OF CLASS I Al-Zn ALLOYS USING A NEW COEFFICIENT

Dr. Mohamoud S. Soliman *

ABSTRACT

The creep data of class I Al - Zn alloys are analysed. The analyses include a comparison between the experimental activation energies for the alloys and those based on the diffusion coefficients proposed for describing viscous-glide- disloca tion creep. Using the approprite value for the diffusion coefficient, the creep rates of the Al-ZN alloys are normalized and compared with the prediction of viscous-glide models. Good correlation is observed between the data of these alloys and the viscous glide models based on the Cottrell-Jaswon mechanism.

KEWORDS

creep, solid solution, Al-Zn alloys, viscous glide, diffusion.

INTRODUCTION

The steady-state creep rate, $\dot{\varepsilon}$, of pure metals and solid solution allyos at high temperatures and intermediate stresses in the range of

$$\text{of } 10^{-5}\, G < \sigma < 10^{-3} G,$$

where G is the shear modulus, is diffusion controlled and can be represented by an equation of the form [1,2].

$$\dot{\varepsilon} = A'(DGb/kT)(\sigma/G)^{n} \qquad (1)$$

where D is the diffusion coefficient that characterises the creep process, b is the Burgers vector, k is the Boltzmann's constant , T is the absolute temperature, σ is the applied stress, A' is a constant that contains structural parameters such as stacking fault energy, grain size and dislocation density and n is the stress exponent.

The creep characteristics of solid solution alloys, as summarized in Table 1, have been divided into two categories class I and class II) based on the value of n and other properties [3,4]. Class II (metal type) alloys have creep properties similar to those of pure metals while the characteristics of class I (alloy type) alloy are differents from those observed in pure metals.

In class I alloys glide motion of dislocations dragging the solute atmospheres is the rate controlling step, and the glide diffusivity, D , as used by many investigator [2,4,5] to describe the diffusion process in viscous glide creep is given by the Draken chemical diffusion coefficient, D [6].

$$D_g = \tilde{D} = m\,(X_A D^*_B + X_B D^*_A)$$

where D^*_A and D^*_B are the tracer diffusivities of solvent A and solute B, respectively, X_A and X_B are respective atomic fractions and m is the thermodynamic factor.

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amounts of straws that can be gathered in the village and thus the transportation problems can be eliminated. The small units of gas producers are already in operation on commercial scale in the industrial countries. Experimental work in this regard has been also undertaken by the authors of this paper (49,50).

6. CONSTRAINTS

The major constraints limiting wider utilization of rice straws and hulls as energy source can be classified into two types. The first is inherent in the very nature of these residues and their alternative opportunity cost. In this regard, the conflict between the use of rice straws as energy source versus their use as animal fodder is particularly important. Handling and transport problems may be considered as another factor.

The second type of constraints are attached to the prevailing local conditions. Two major deterrents are worthy of noting. The first follows naturally from the inadequate local energy pricing system. The highly subsidised fuel prices, being at times less than one tenth of the international market price level, tend to decrease the impact of any alternative energy source including rice hulls and straws. The second factor relates to the very low efficiency of prevailing rural stoves and ovens. Development of well-designed inexpensive burning devices does not only help in reducing the rural sector reliance on highly subsidised commercial energy sources, but would also have a considerable beneficial impact regarding the abatement of atmospheric pollution.

7. CONCLUSIONS AND RECOMMENDATIONS

— Utilization of agricultural residues, particularly rice hulls should be enhanced as a renewable energy source whenever is appropriate (in situ use in rice mills).

— The subsidised pricing structure of petroleum fuels has a negative impact on the utilization of the agricultural residues as source of energy. Review of this pricing system is therefore highly needed. Redirection of the governmental subsidies to such renewable source would be of very beneficial value.

— Development of improved rural stoves and ovens utilizing aricultural residues to attain higher efficiencies is needed on a priority basis. Small-scale, efficient gasification unit are also worthy of attention.

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from mills using hull-fired boilers to provide the heat for rice parboiling (4). Several parboiling mills in Italy and Sri Lanka use steam produced with husk. This type of rice is expected to be produced in the near future because of the demand on it in the foreign markets.

Some reports (11) indicate that about 600-800 kg steam are required for every ton of paddy by the parboiling process. As one ton paddy produces about 200 kg hulls and for efficient boiler, one kg rice hulls can produce 3 kg of steam. Thus, about 600 kg of steam can be obtained using the hulls produced from one ton of paddy. Accordingly, this process can almost utilize the total energy of rice hulls. Thus, for mills planning to produce parboiled rice, it is worthy to construct boilers using rice hulls as fuel to produce the steam required either for the parboiling process or for drying purpose.

4.2. Motive Power

Rice hulls can be utilized in the operation of rice mills, For example, most rice mills in Indonesia and Philippines have internal power requirements of 50 to 500 kW small compared to most mills in Europe or the USA and small compared to some mills in Thailand (23). This can be achieved by many ways; generation of steam and transformation it into mechanical power in one mean.

However, after modernization of the mills, it is difficult to return to the use of the steam engines to drive the rice milling machines. Production of electricity appears more suitable. However, this method requires large production rates of hulls as fuel and thus can be used in large mills. An average U.S. mill can process 25 tons per hour (some as high as 80 ton/hr) and operates for 10-11 month per year (23). The excess electrical energy can then be soid using the national electrical grid.

Producer gas can be produced to operate some engines in the milling process and is suitable to both large and small mills.

4.3. Rice Bran Stabilization

The action of enzymes deteriorates the rice bran after milling process. The free fatty acid content can increase to a high extent in warm climates within few days, rendering the oil non-edible. Many treatment processes have been developed to stabilize the bran. All of them depend on heat treatments, either wet or dry.

Stabilization of rice bran can thus be furnished depending on the energy produced from rice hulls. It is worthy to mention that the stabilization of rice bran is very important in Egypt due to the shortage of edible oils.

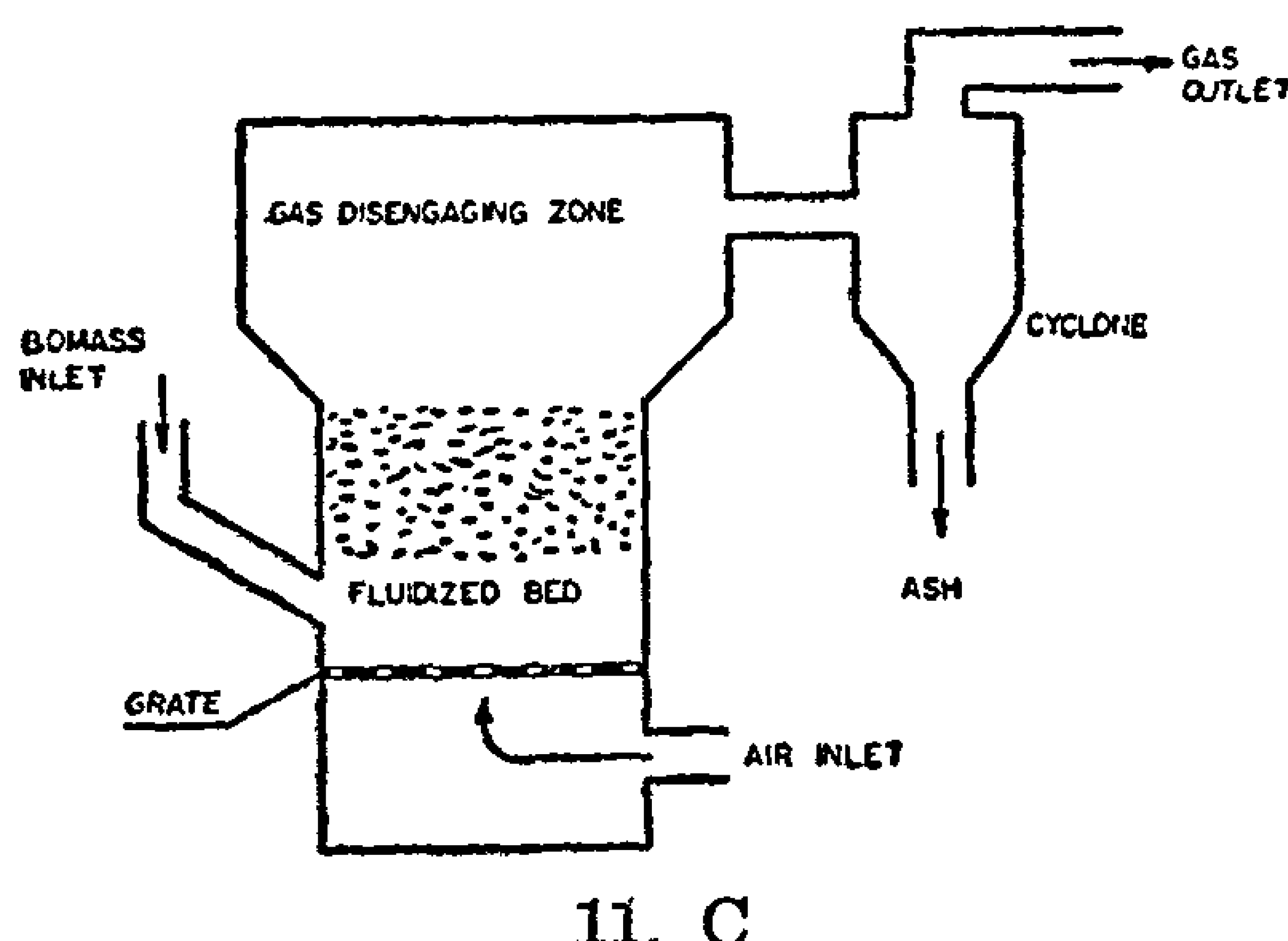
5. FIELDS OF UTILIZATION OF RICE STRAW ENERGY

5.1. Residential Uses

Residential uses is the more promising field for utilization of rice straw as an energy source. This fact arises from the spreading of rice straw allover the rural areas in quantities ranging from a portion of a ton per year to a few tons per year depending on the farmers/and ownership. Utilization of these straws on the spot would be more economic. Much of the straws is utilized today in the low efficiency rural stoves and ovens. Accordingly, it is important to develop more efficient rural stoves and ovens and propagate their use on a wide scale. Through the use of such developed stoves and ovens, the efficiency can be doubled and thus a huge savings in energy would be accurued.

5.2. Agricultural Uses

Small scale producer gas units can be constructed to operate irrigation units and amounts of straws that can be gathered small scale rural industries by using the



11. C

Fig. (11) Types of Gasifiers (12).

3.3.1.4. Fluidized bed gasifiers

These are steel reactors lined with refractory material, that are used for gasification of very small sized material. Fluidization is ensured by means of inert materials (sand) maintained in whirling motion by a fan, placed at the reactor base, blowing in air and a portion of the produced gas, in controlled proportions. Fuel is fed through a screw conveyor provided with an airtight device.

Reaction takes place at a temperature of 600 to 800°C produced by partial combustion of a portion of the fuel and the temperature gradient along the reactor is more or less constant.

In these gasifiers, the gas purification stage is, in general, more laborious due to the greater quantities of solid driven particles. To this end, the produced gas is conveyed through a cyclone for preliminary dust (ashes) separation: then, it undergoes scrubbing for removal of condensable fractions and, if necessary, it goes through another cyclone for additional filtering. A simplified section is shown in Figure 11.d.

3.4. Fermentation to Produce Ethanol

Extensive work has been done particularly over the past decade to ferment the agricultural residues to produce ethanol. The fermentation process is generally preceded by a hydrolysis step to produce glucose. Ethanol mixed with petroleum oil is now used as fuel for internal combustion engines in Brazil. Baggase is the most suitable residue for ethanol production (46,47). Rice straw is suitable, but hulls produce the least amount of alcohol.

3.5. Anaerobic Digestion (Biogas Production)

Fermentation of agricultural residues under anaerobic conditions to produce biogas (consisting of about 60% methane, 40% carbon dioxide and small ratios of hydrogen and hydrogen sulfide is one of the presently available technologies. Thus, in China, huge amounts of rice straw is fermented to produce biogas in rural areas. Generally, the straw should be mixed with high nitrogen source such as pig manure, or human excreta to sustain the required C/N ratio required for efficient digestion.

Rice hulls also can be digested, but it is more difficult than rice straw, and the gas production rate is quite low. Thus, rice hulls are not recommended for digestion without pretreatment.

If the amounts of rice straw utilized already today as solid fuel using the traditional low-efficiency stoves and ovens are fermented to produce biogas, an amount of gas equivalent to about 0.15 million ton kerosine can be produced per year. It is worthy of mention that many demonstration plants have been installed in the rural areas of Egypt (48). Experiments on the use of vairos agricultrual residues are conducted in the context of this project.

4. FIELDS OF UTILIZATION OF RICE HULLS ENERGY IN RICE MILLS

4.1. Parboiling

Parboiling of rice is getting to be a world-wide known process due to its value in increasing the nutritive value of rice and other properties as well as in decreasing the losses during milling. Mahin (3) reported that about 20% of the world's rice is converted or parboiled. Among developing countries, the practice is most common in South Asia. About half of the production of parboiled rice in India is

3.3.1. Type of gasifier

Gasifiers can be divided into four basic types, namely (12):

— Fixed bed, updraft gasifiers.

— Fixed bed, downdraft gasifiers.

— Fixed bed, crossdraft gasifiers.

— Fluidized bed gasifiers.

3.3.1.1. Fixed-bed updraft gasifiers

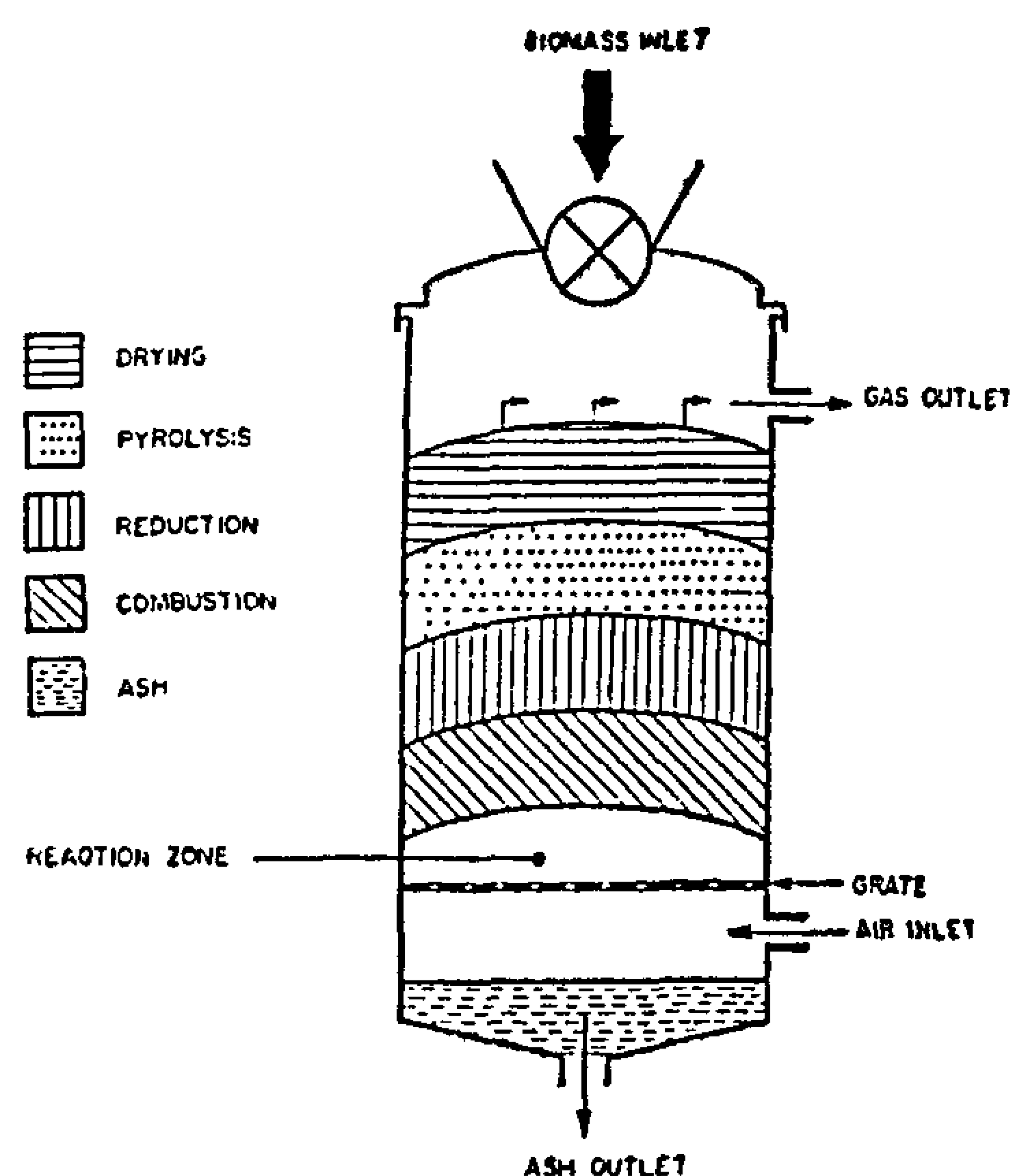
Gasifiers of this type are essentially carbon steel vessels lined with refractory materials. A grate arranged at the reactor bottom supports the fuel bed which is loaded from the top through an airtight device. Air is introduced under control into the combustion zone at the grate level where temperature attains its maximum rate thus supplying the heat required for the whole process; the gas produced by combustion is conveyed upwards and reacts with the top layers of fuel, exiting then from the gasifier top (Figure 11.a).

3.3.1.2. Fixed-bed downdraft gasifiers

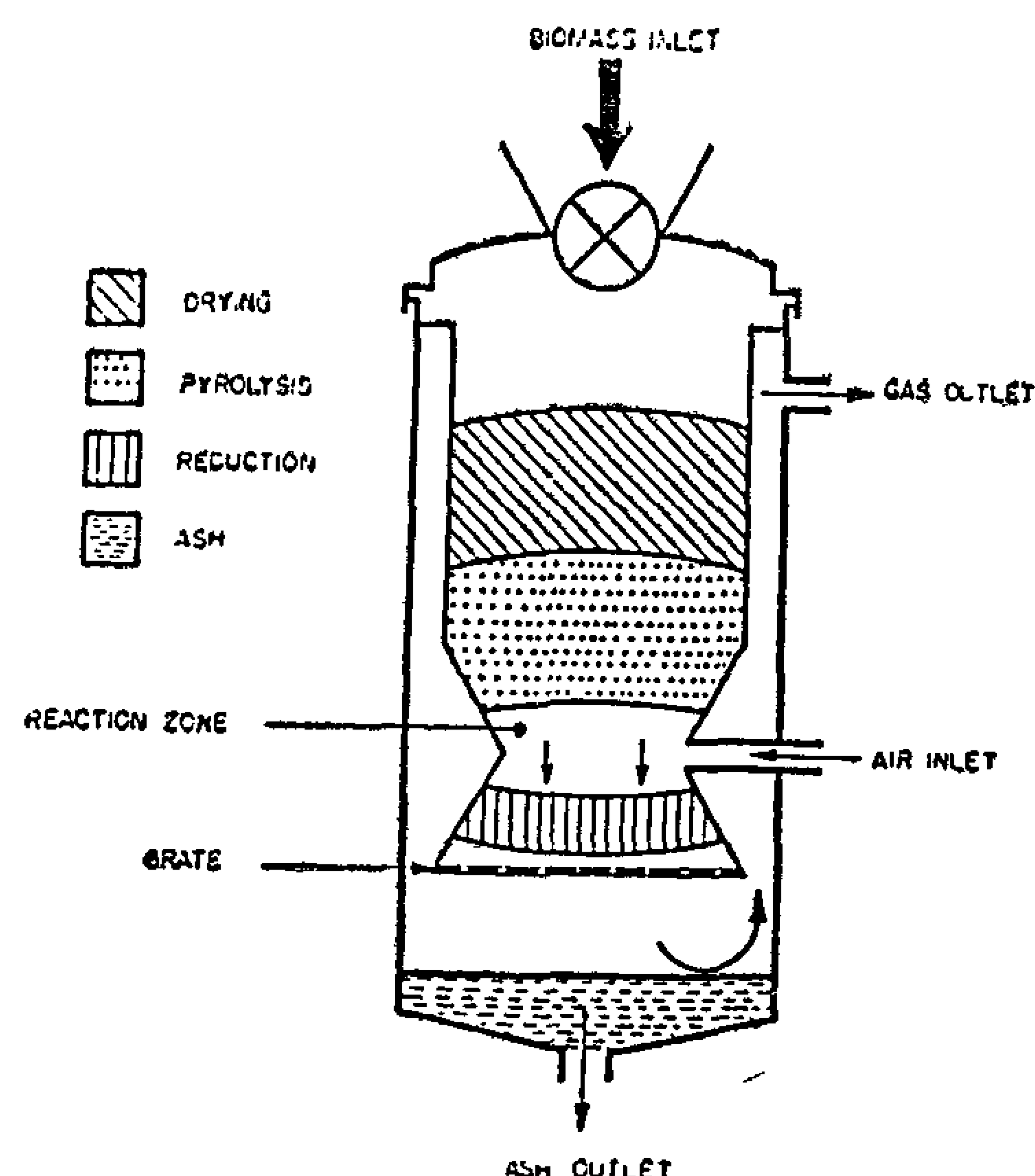
As for the updraft one, this gasifier consists of a carbon-steel vessel lined with refractory material and provided with a bottom grate and with an airtight fuel loading system arranged on the top of the reactor. Whilst in the preceding case air was introduced from below through the grate and gas was flowing upwards, in this case air is introduced into the reaction zone or immediately on top of it. The gas produced is conveyed downwards and then upwards along a circular liner until it comes out from the reactor top (Figure 11.b).

3.3.1.3. Fixed-bed cross draft gasifiers

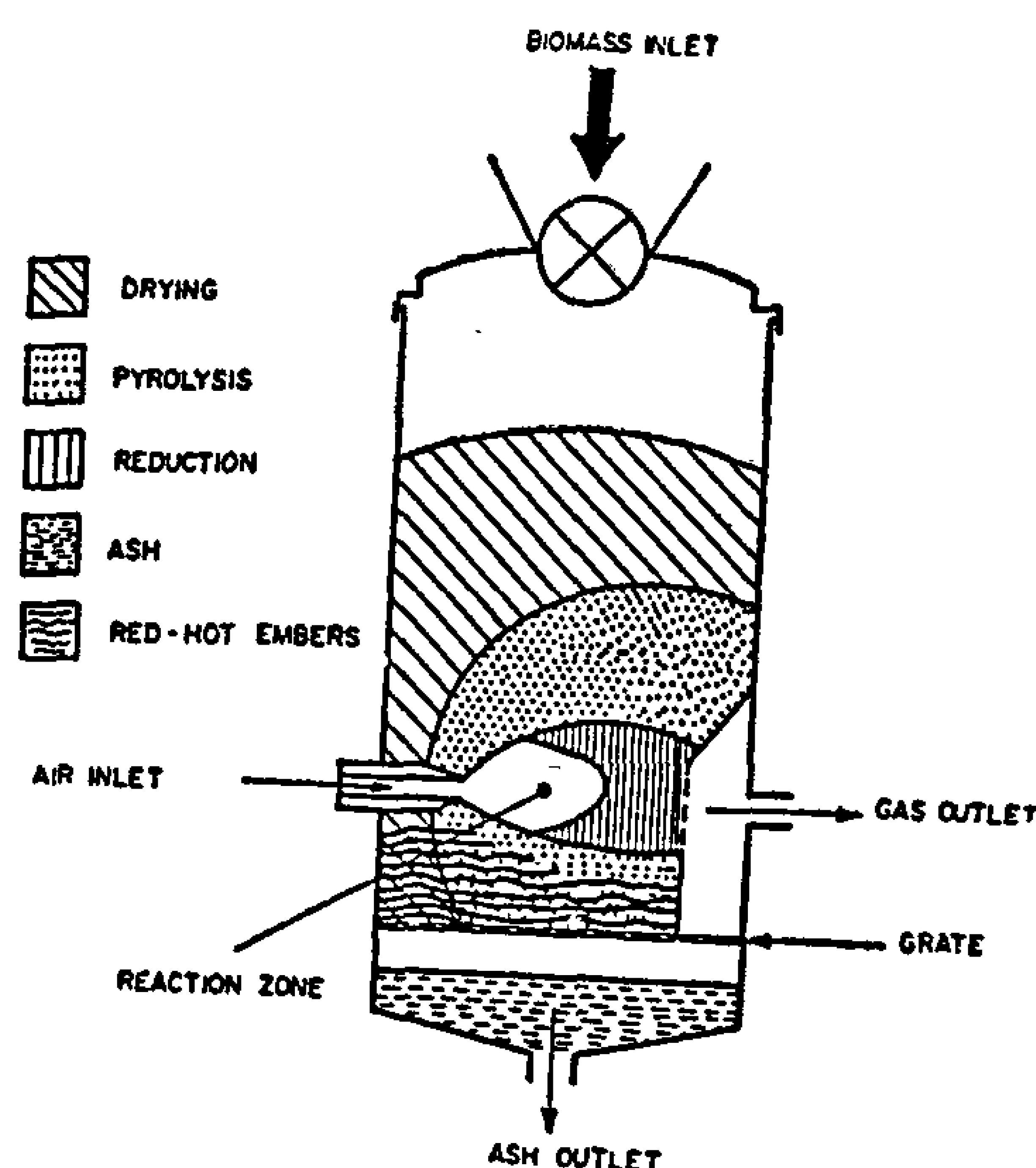
Figure 11.c illustrates a schematic secton of a fixed bed cross flow gasifier. In this type the fuel flows down while the air needed for combustion is fed from one side and the produced gas leaves from the other side.



11. a



11. b



11. C

Producer gas can be u'lilized for steam generation, operation of internal combustion engines or drying as a substitute for petroleum oils. A small gas engine of 5 hp and higher can operate economically under approriate conditions. Coupled with generating units, these gas engines would prove to be a valuable source of power for general industrial and lighting purposes, and particularly for developing the rice industry. Figures 8 & 9 illustrate two gasification power plants of capacity 60 & 160 kW respectively used in China and is suitable for medium and large size rice mills (34,35).

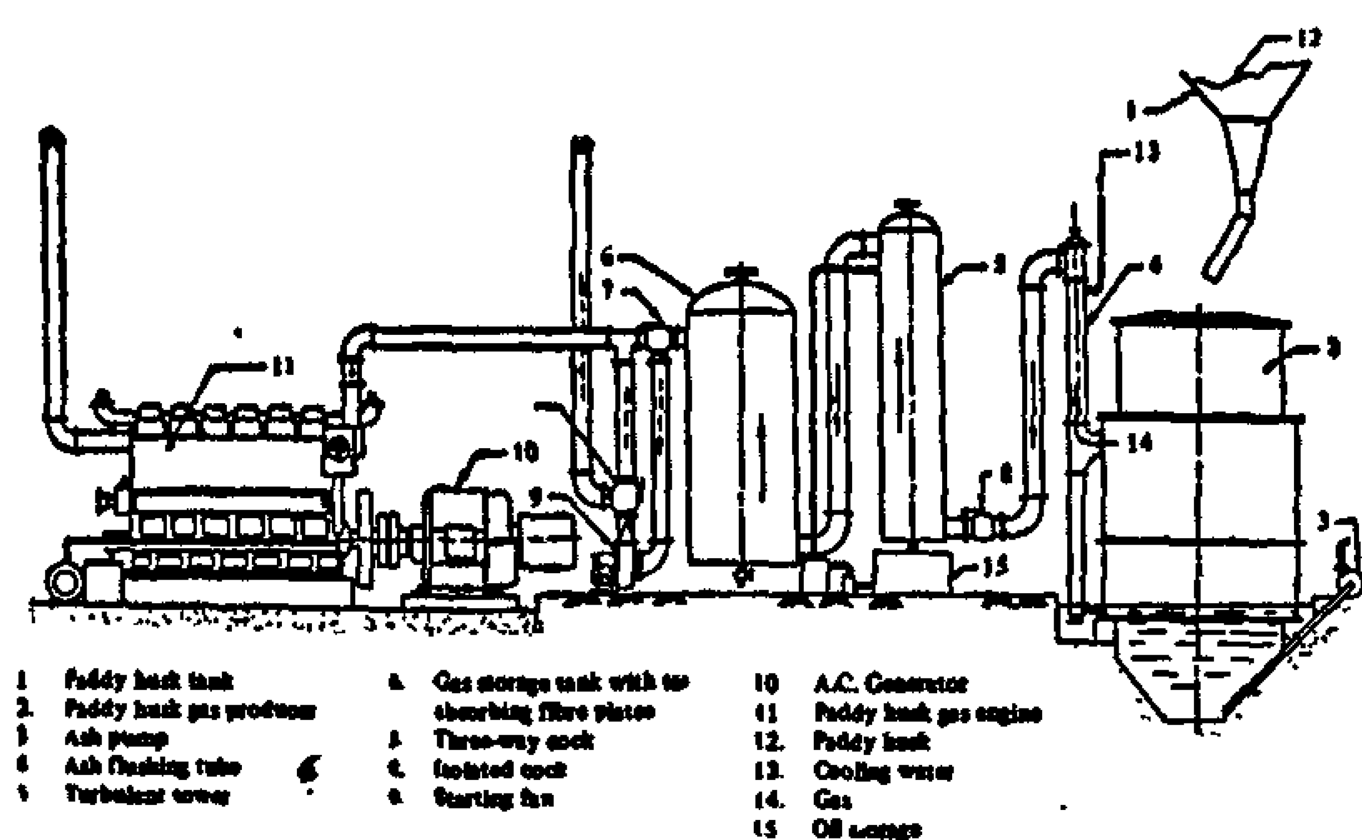


Fig. (8) Layout of the 60-KW Rice Hull Gasification Power Plant (34)

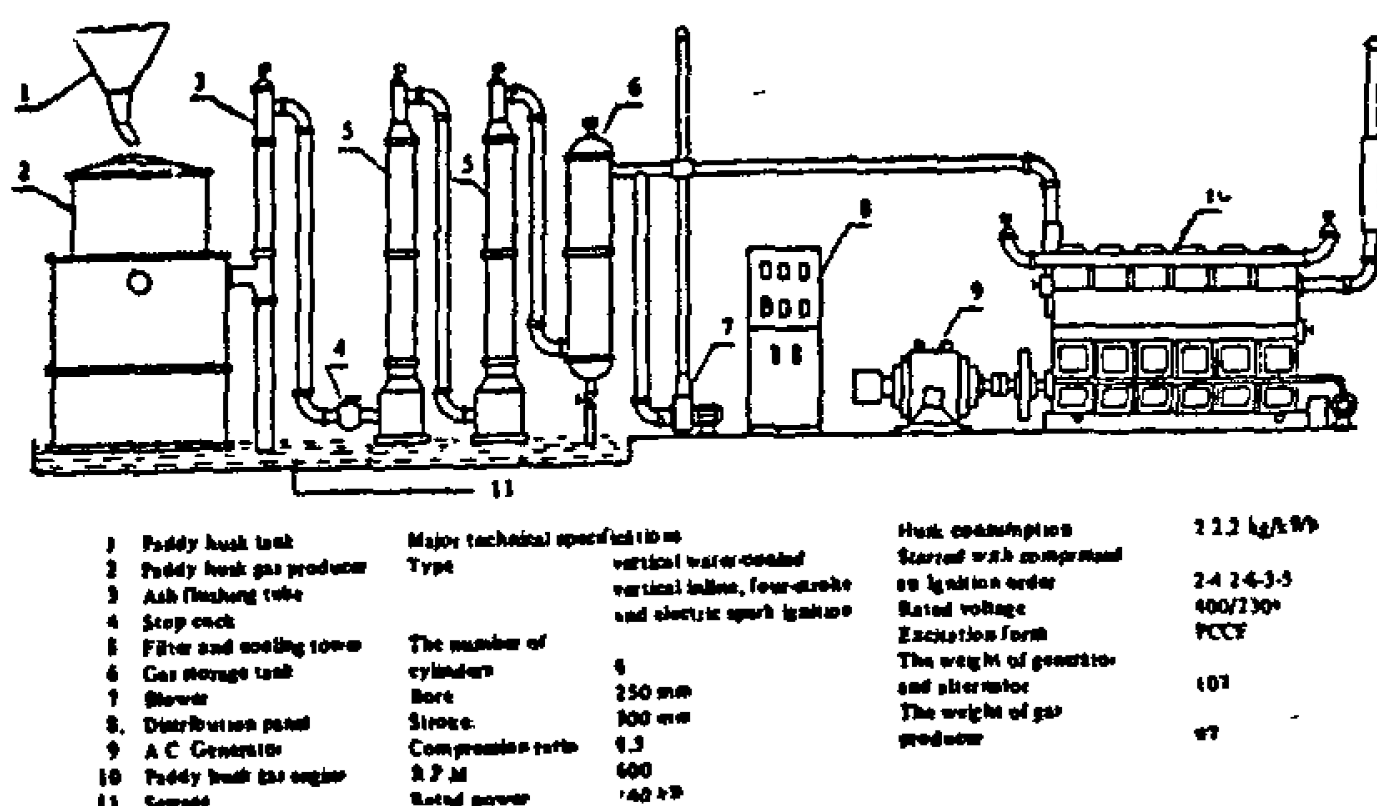


Fig. (9) Model 6250 M1 Rice Hull Gasification Power Plant (35).

A lot of work has been done on the development of the gas producers operating on agricultural residues (8,36-45). The physical magnitudes influencing efficiency of the gasification reaction are: Temperature, pressure, gas velocity, fuel layer thickness, fuel type and size.

Figure 10 depicts the effect of gasification temperature on the composition of fuel gas produced.

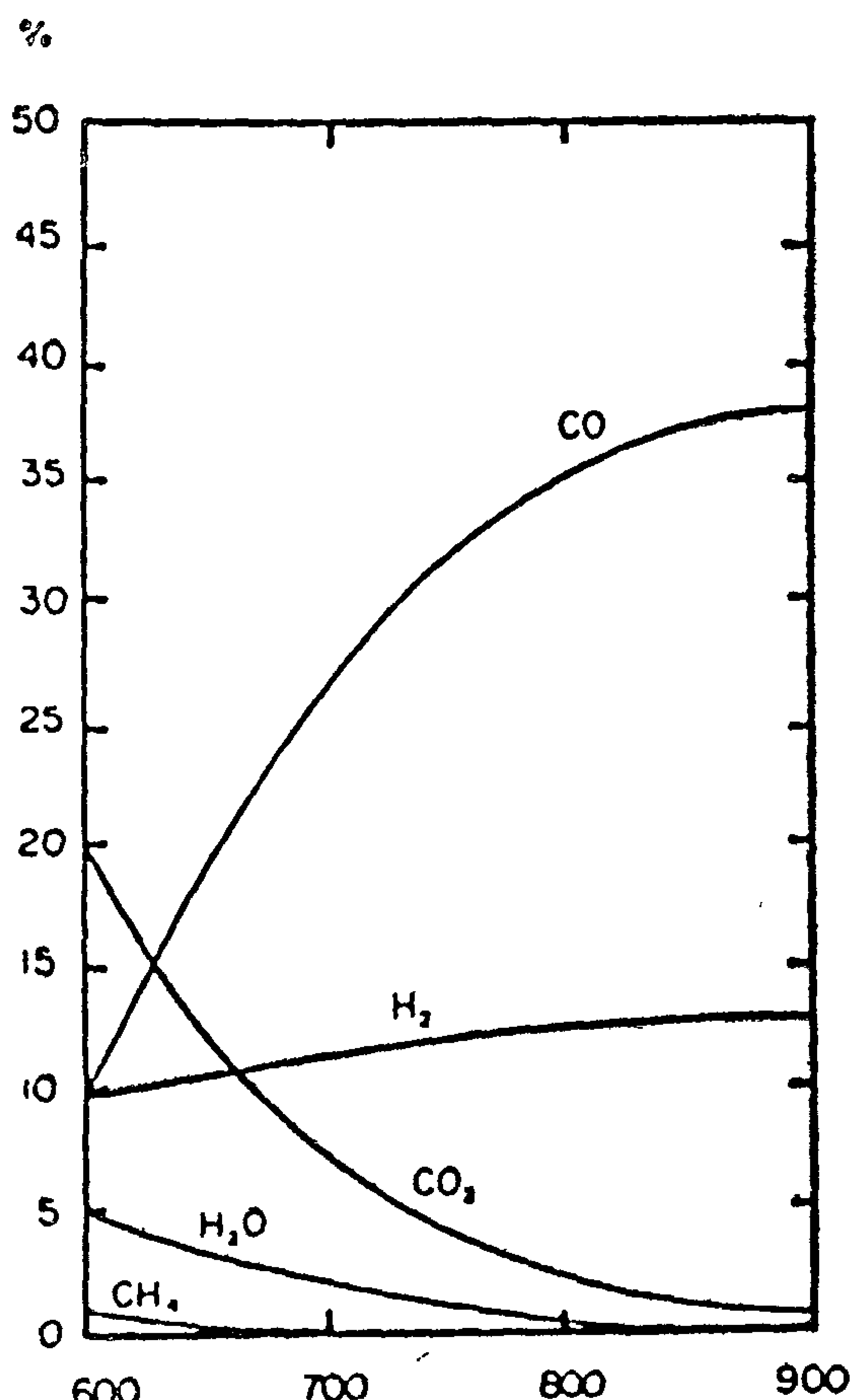


Fig. (10) Gas composition Vs. Reaction Temperature. (33)

Gasification efficiency E can be defined as the ratio of the thermal energy of the gas produced to the thermal energy of the fuel used, according to the following formula:

$$E = \frac{V_g \times HV_g}{HV_s}$$

where:

V_g = Produced gas volume by one kg of solid fuel in m^3.

HV_g = Heat value of produced gas in kcal/Nm^3.

HV_s = Heat value of solid fuel in kcal/kg.

A pyrolysis combustion process for high ash agricultural residues such as rice hulls and straw was proposed (5). The flow diagram of the process is given in Figure 7. The process depends on the pyroiysis of the residue to drive off the volatile matter, then combustion of char residue in controlled oxygen atmosphere to assist the complete combustion of the organic matter. Energy balance of the process shows a heat recovery of more than 80%.

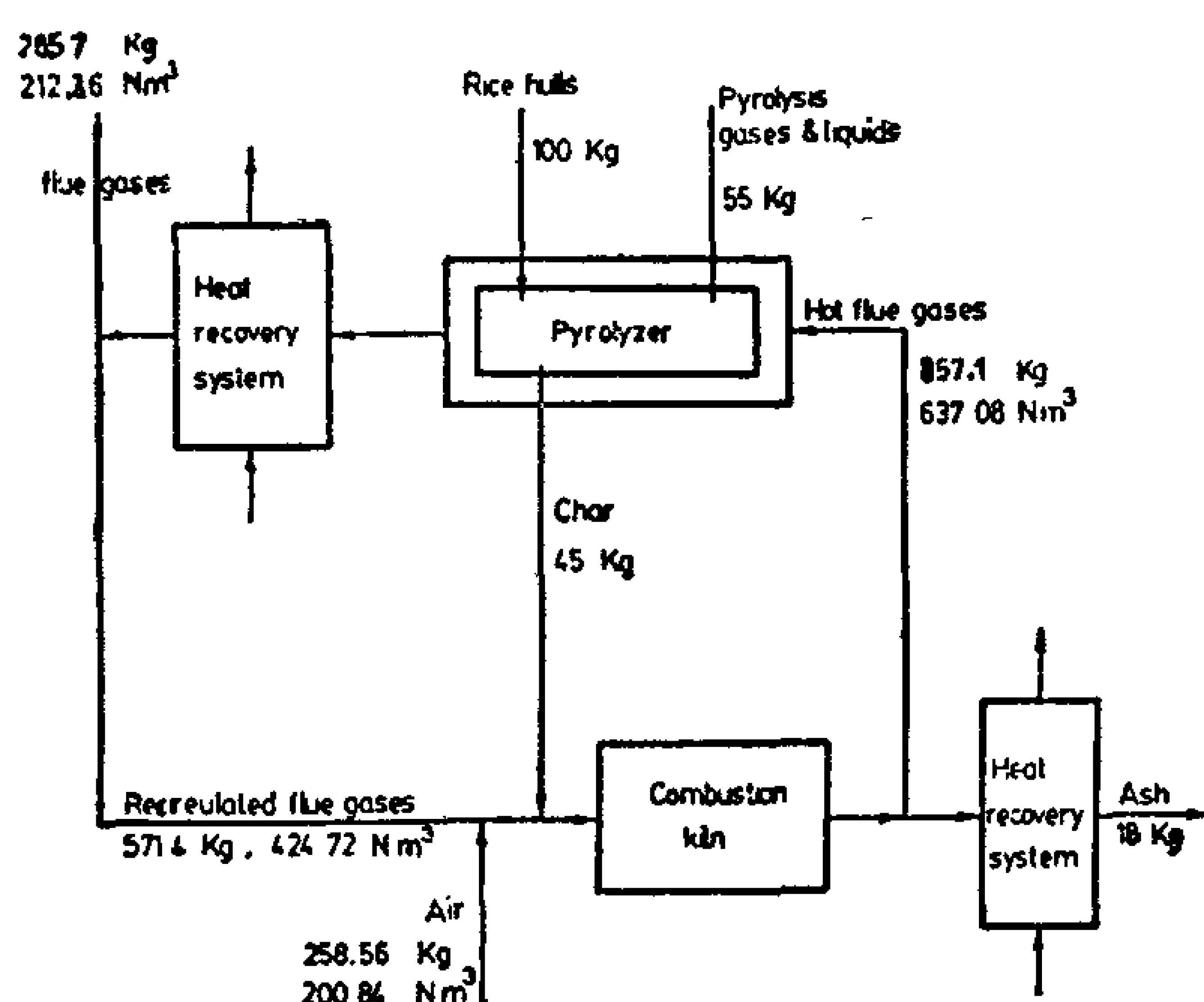


Fig. (7) Overal Material Balance of the Pyrolysis-Combustion Process of Rice Hulls (5)

3.3. Gasification (Producer Gas)

Gasification means partial combustion of ligneouscellulosic or carbonaceous maerial through a controlled introduction of oxygen in a vessel and consequent transformation of the starting products into fuel gases. In general, the oxygen-source is air. The clean gas which is obtained has a mean heating value ranging between 900-1100 kcal/Nm^3. The combustible fraction consists of CO, H2 and CH4; whilst the inert or non combustible fracton consists of N2 and CO2. In the rather uncommon case of direct utilization of oxygen, the heat value of the produced gas would reach values of 2200-3100 kcal/Nm^3 (12).

Beagle (11) reported that by adding steam to the primary air, H2 and more CO are formed. Accordingly, the addition of steam increases the heating value of the produced gas and also reduces the sticking of the residue. It was also reported that the heating value of the producer gas reaches an optimum when the air supply contains 0.4 kg of steam per kg of fuel (11). The composition of the gas thus produced and its calorific value as follows:

CO_2	4.2- 7.7 %
O	2.4- 2.8 %
H	4.8- 7.8 %
CH_4	7.2- 4.5 %
CO	25.0-22.7 %
N	56.4-54.5 %

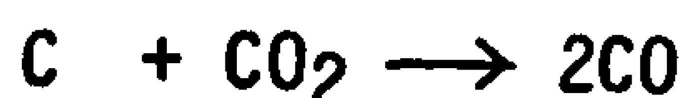
Calorific Value (C.V) = 1586.0-1350.0 kcϵ 'm^3.

The oxidation reaction occuring in the combustion zone between air and fuel are (33):



$$C + O_2 \longrightarrow CO_2$$

$$\Delta H = -97650 \text{ kcal/kmole} \quad (1)$$



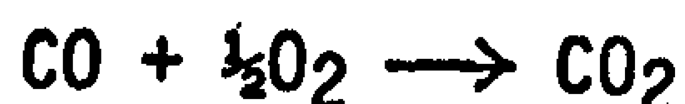
$$C + CO_2 \longrightarrow 2CO$$

$$\Delta H = +38800 \text{ kcal/kmole} \quad (2)$$



$$C + \tfrac{1}{2}O_2 \longrightarrow CO$$

$$\Delta H = -29400 \text{ kcal/kmole} \quad (3)$$



$$CO + \tfrac{1}{2}O_2 \longrightarrow CO_2$$

$$\Delta H = -68200 \text{ kcal/kmole} \quad (4)$$

As the summation of the thermal tanalities of the various reactions is positive, by introducing steam into the reaction mass, thus obtaining the:



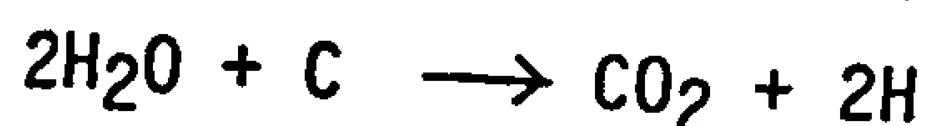
$$H_2O + C \longrightarrow CO + H_2$$

$$\Delta H = +28800 \text{ kcal/kmole} \quad (1)$$



$$H_2O + CO \longrightarrow CO_2 + H_2$$

$$\Delta H = -9400 \text{ kcal/kmole} \quad (2)$$



$$2H_2O + C \longrightarrow CO_2 + 2H$$

$$\Delta H = +18800 \text{ kcal/mole} \quad (3)$$

and gas with a higher heat value.

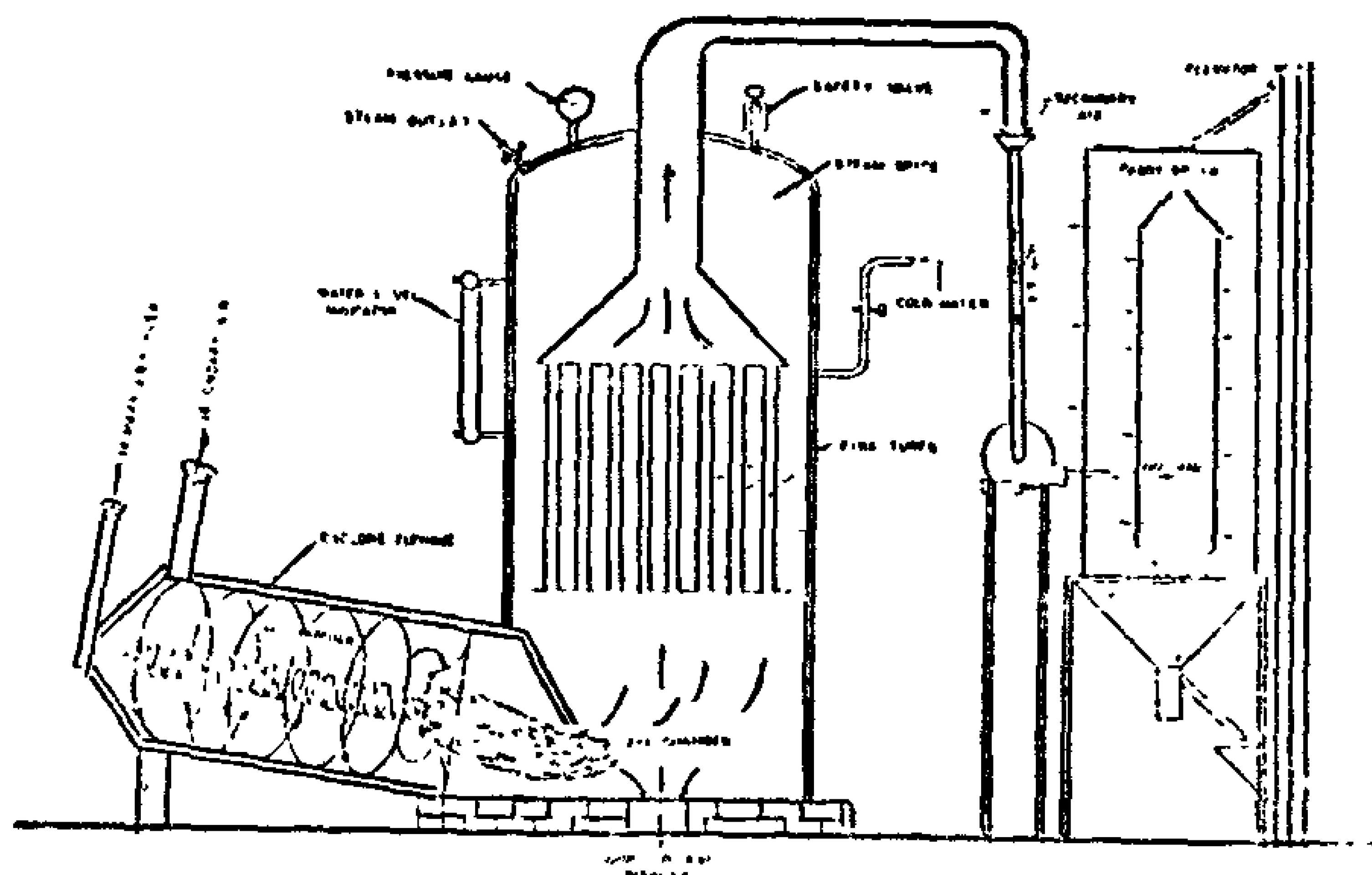
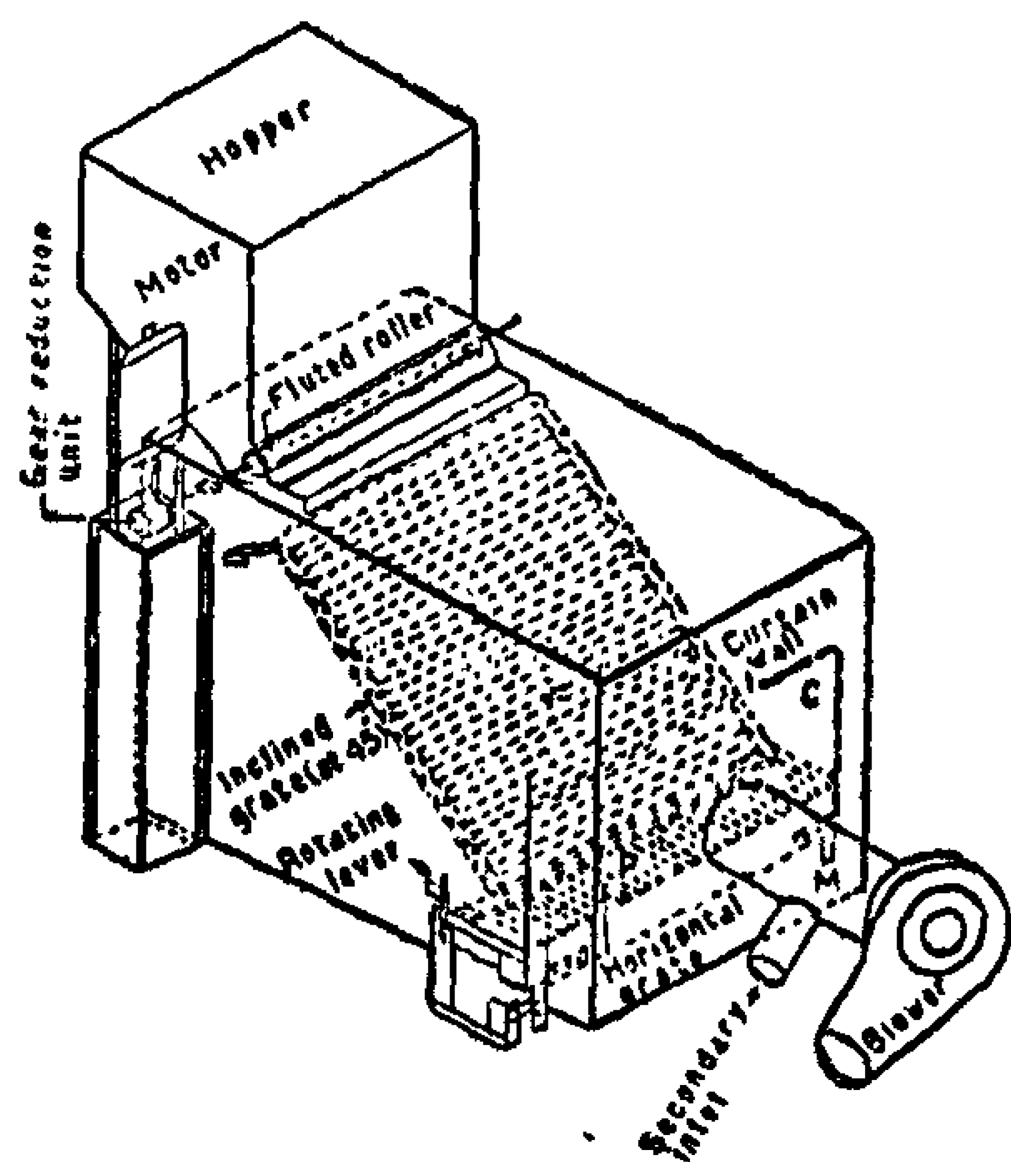


Fig. (5) Cyclone Furnace, Steam Generator and Paddy Dryer(25)

A pilot plant was established in which steam was produced by burning agricultural wastes in the horizontal cyclone furnace (Figure 6). The heat content in exhaust gases from the steam generator was utilized for drying to minimize stack losses. The hulls were introduced in the cyclone chamber by means of fluted roller placed in the hopper and with the help of a stream of air. The furnace was fired first with rice straw. A high efficiency of 78.5% was reached (28). In Figure 6, the cyclone furnace coupled with steam generator for parboiling and grain dryer operating on the stack flue gases is shown.



F — Furnace Space.

P — Precipitation Space.

M — Mixing Space.

C — Combustion space.

Fig. (6) An Isometric View of Hull Fired Furnace, (25)

3.1.2.3. Fluidized bed furnaces

A furnace of such type has been operatng in India (near Calcutta) using rice hulls. The combustion process takes place mainly in a fluidized bed. The ash is removed periodically. Carbon content of the ash is lower than that of the step grate furnaces and higher efficiencies are reported for this furnace. The energy obtained is used for drying purposes in the rice mill.

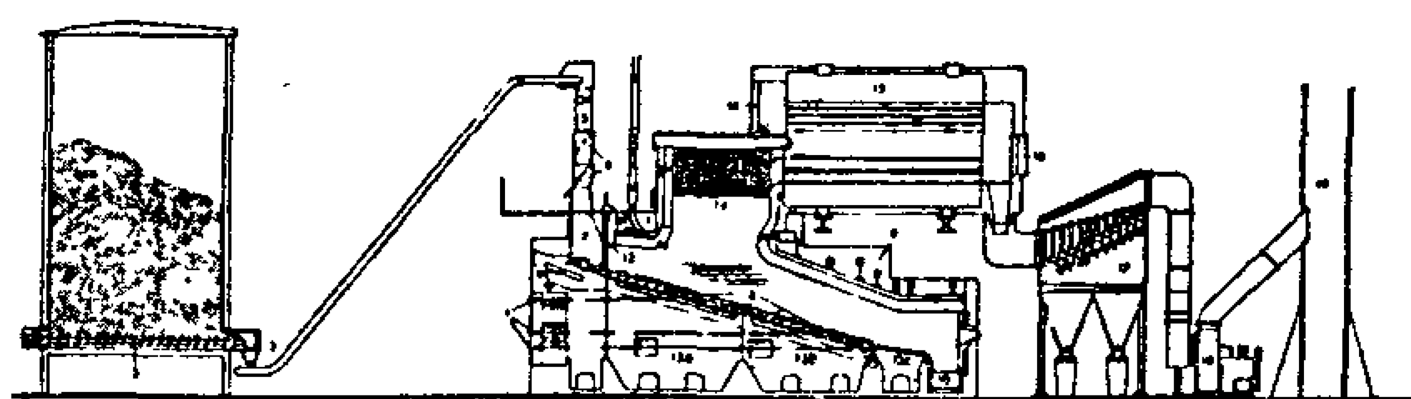
3.2. Pyrolysis

Pyrolysis is generally known as the thermal decomposition of cellulosic residues in absence of oxygen (26,27). The promise of pyrolysis in Less Developed Countries as a technology for converting the vast quantities of agricultural and forestry process wastes available into clean fuels has not yet been realized (28). Many investigators have employed the process of pyrolysis using different residues (29-32). Rice hulls and straws can be thermally treated to produce gases, oils and solid residue all of which are sort of fuel.

The pyrolysis process can be carried in many different ways. However, the more promising is the flash pyrolysis technique. In this process, the hulls or straws are subjected to the high temperature for a very short period (seconds or fraction of a second). Under these conditions, a high proportion of the material is transformed into liquid and gas phases the amount transferred is more than the volatile content of the material. Thus, a part of the fixed carbon is reduced to form a gas or liquid phase. Rice hulls were processed using Garret flash pyrolysis (32). About two barrells oil was obtained from one ton rice hulls. Boucher and Coworkers(32) obtained some results for the flash-pyrolysis of rice hulls at different temperatures in the range 421-518°C. Gases and oils produced can be used as an energy source. Char can as well be used as fuel after briquetting or as adsorpent materials. A pilot unit of this type was built in California, USA.

3.1.2.1. Step-grate furnace

Figure 3 illustrates the movable inclined step-grate furnace, which is known to have high efficiency. The reported efficiencies of such types are about 40% (11). Low efficiency is due to the incomplete combustion of rice hulls which is exhibited by the high residual carbon in char after burning. These types of furnaces are characterised by the high cost of removing the ash, since it is mostly done manually.



1. bin
2. travelling screw conveyor
3. screw collector
4. conveyor belt
5. fuel distributing apparatus
6. fuel feeding flaps-type apparatus
7. feeding chute
8. grate
9. furnace bloc
10. ash pit
11. hydraulic cylinder and connecting rods
12. fuel layer thickness regulator
13. a,b,c, undergrate blast zones
14. intermediate casing
15. three pass boiler
16. cleaning doors
17. flue gas dust extraction plant
18. induced draught fan
19. chimney

Fig. (3). Movable Inclined Step-Grate Furnace (11)

3.1.2.2. Air suspended furnaces

In these type of furnaces, the particles are burned in turbulent air flow while suspended and flowing with the air stream. The air velocity should be high (about 3 m/sec) to allow for convection of particles.

3.1.2.2.1. Mehta furnace

Mehta (24) developed a furnace of such type as illustrated in Figure 4. The furnace consists of a feeder, furnace, boiler, ash collector and draft fan. A continuous flow of hull is delivered by a mechanical feeder from a surge bin to the furnace, where the hulls ignite. Combustion air is supplied by an induced draft. The hot combustion gases and ash residue pass from the furnace through the heat-recovery boiler to dust collector in which the ash is removed from the exhaust gases. A high quality amorphous ash is produced containing low ratio of residual carbon.

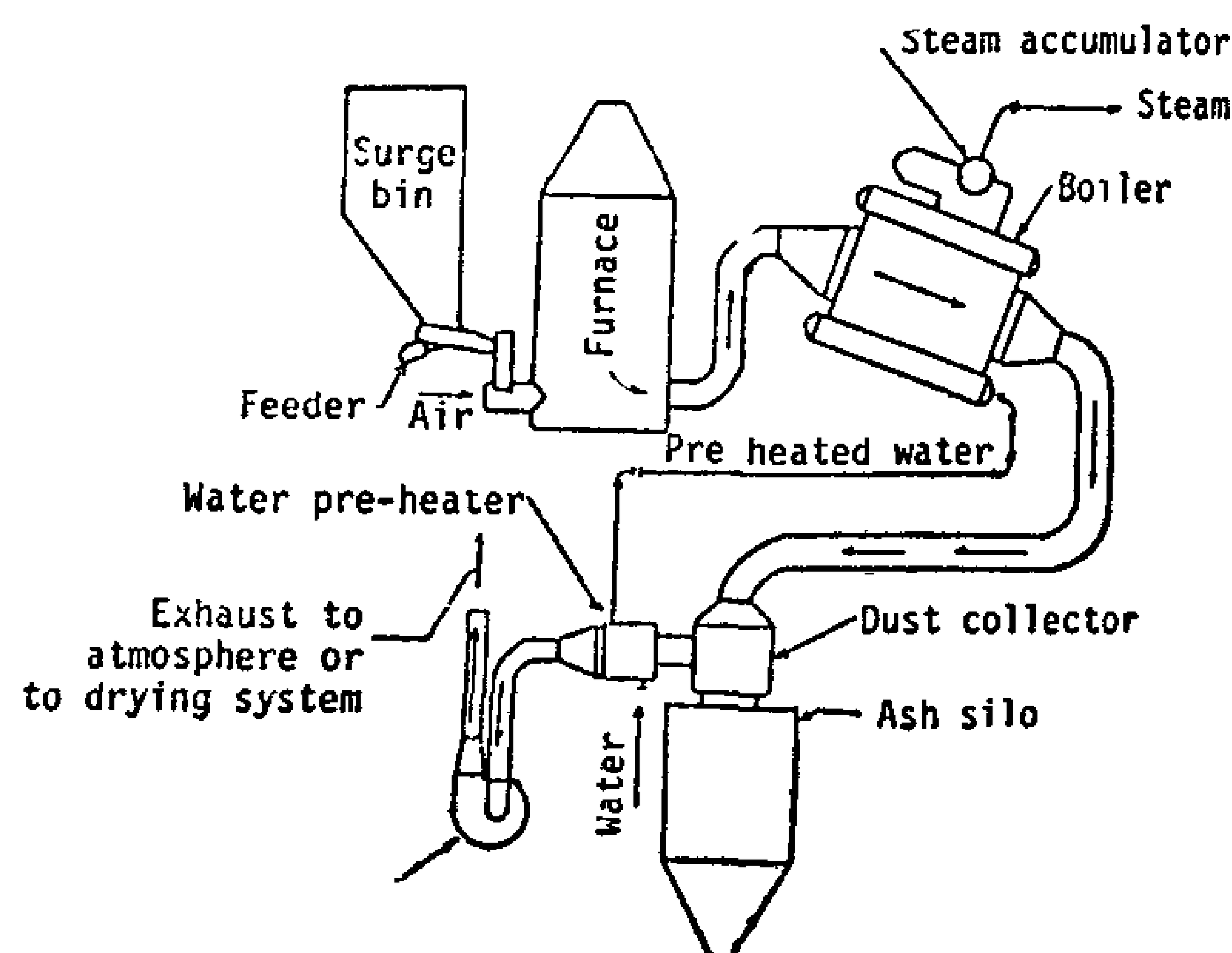


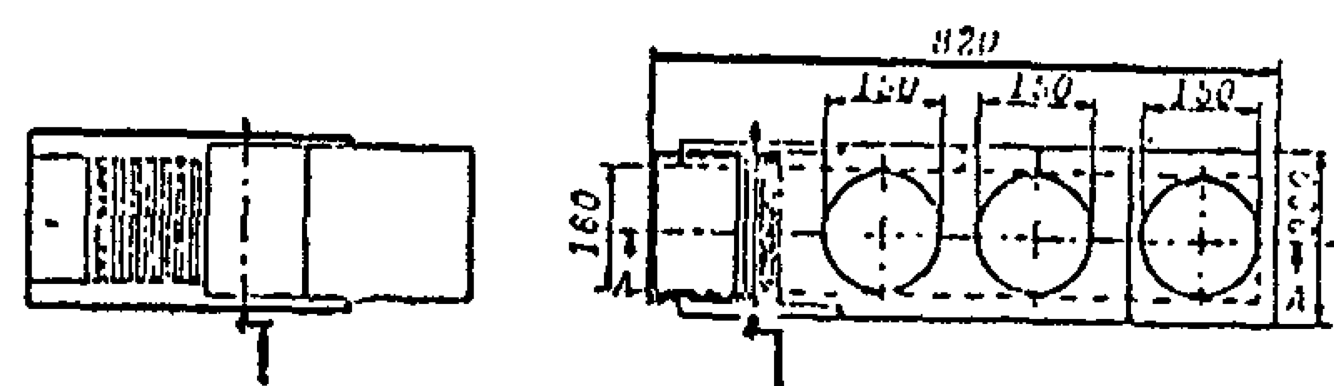
Fig. (4) Schematic Flow Diagram of Plant for Producing Steam (24).

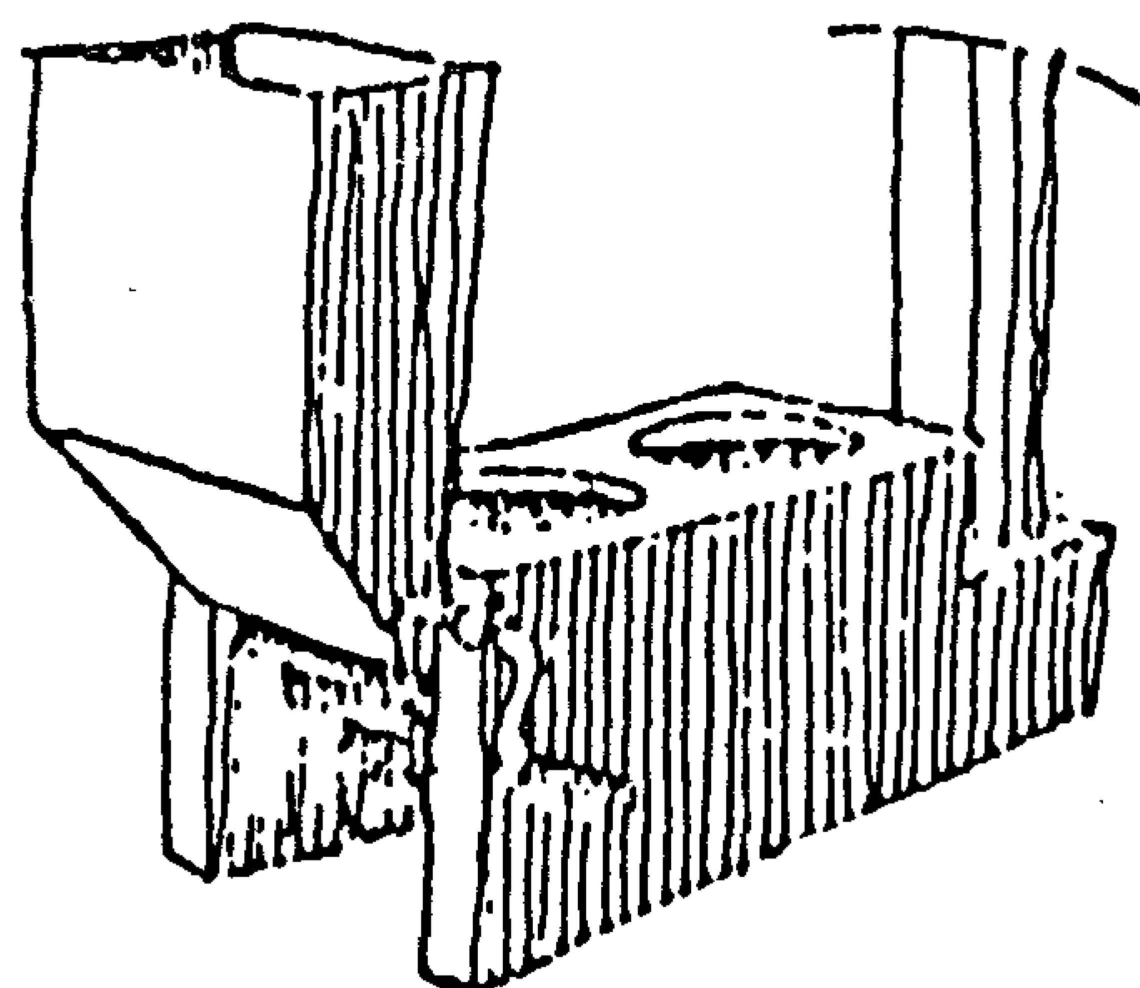
The furnace is a fabricated steel refractory-lined vessel having neither grate nor other moving parts. The entire system has essentially only two moving components: the husk feeder and the draft fan. The unit can produce about 3 ton steam at 10 atm using one ton rice hulls as fuel material. Such furnaces are already operating on commercial scale in California, U.S.A. (11).

3.1.2.2.2. Cyclone furnace

In order to burn the rice hulls and straw efficiently, experiments were carried in India (25) to use cyclone furnace for this purpose. The developed furnace is shown in Figure 5. The hulls were introduced tangentially at the outer end of the cyclone. A high capacity blower was used for conveying the hulls. High efficiency in the order of 80% was reached. The maximum achieved temperature of the flue gases was about 1000°C. The furnace was also operated on firing rice hulls and straw.

stove). Studies have shown that, by placing a grate inside the stove at a particular depth and reducing the size of the flue gas exits and fuel feed mouth, the overall efficiency can be raised from 15.7% to about 28.8%. Single pot, twin pot and triple pot stoves have been developed for large scale communty cooking. To solve the smoke problem, a chimney is incorporated.





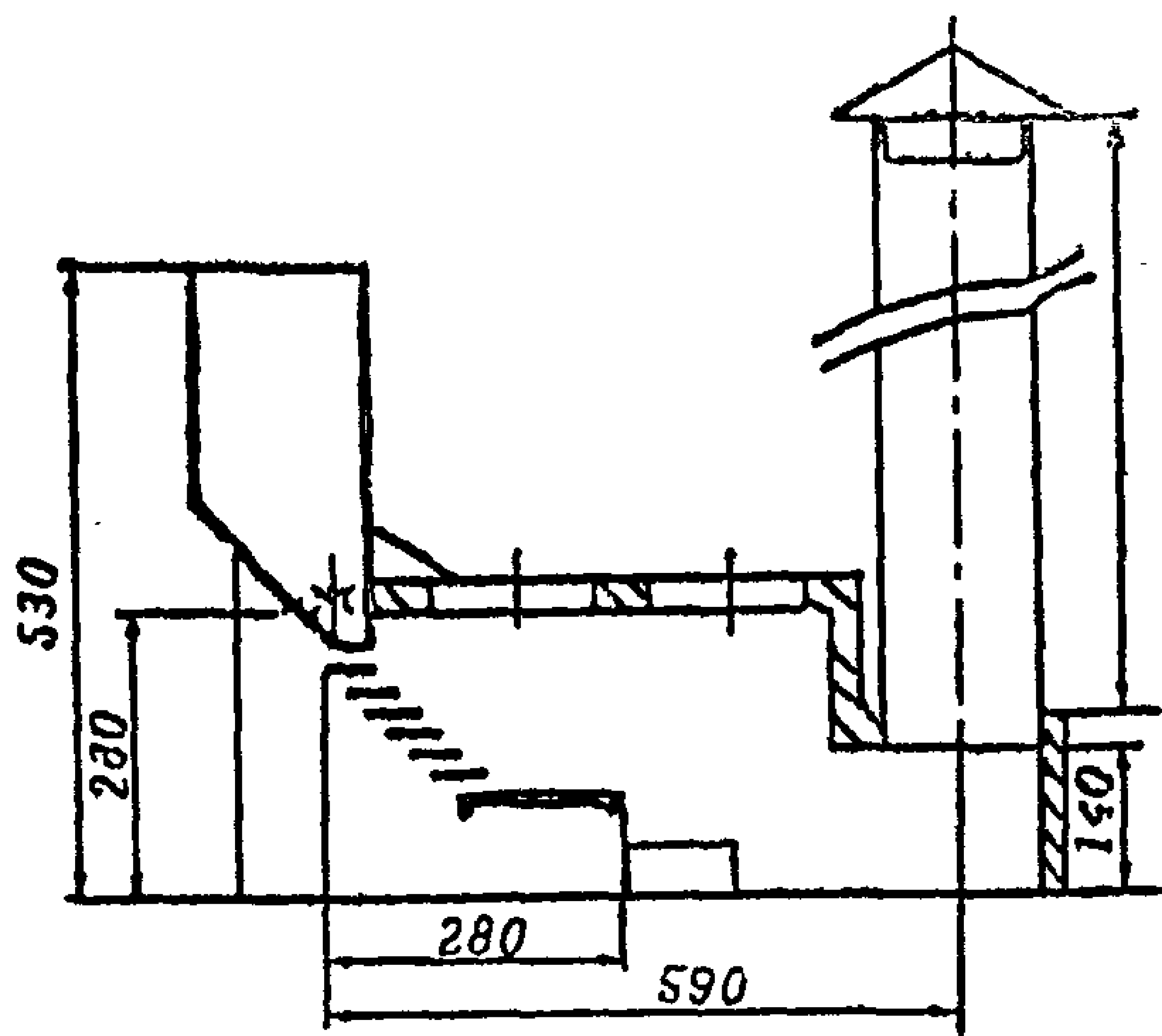


Fig. (1) Rice Hull Step-grate Stove(16)

The rate of burning of the fuel can be controlled by covering the primary and secondary air ports by steel plate with circular holes. Many such and other innovations have been described in several excellent treatises (18). The potential of rice hulls as domestic fuel in Egypt, however, appears to be quite limited on account of the availability of other agricultural residues in rural areas. On the other hand, rice straw is sometimes used as domestic fuel. Nevertheless, because the stoves in current use are not efficient, the available energy from rice straw and other residues is low. Much work is needed on a priority basis for development of more efficient stoves. Experimental work along these lines has started and good results have been obtained (19,20).

3.1.2. Industrial uses

Rice hulls and straws can be burnt using specially designed furnaces. The recovered heat can be used for raising steam, for processing requirements or for electricity generation, etc... either in the rice mills themselves or for agricultural uses in the villages (11,21-25). Figure 2 illustrates a complete rice hult combustion plant with a maximum feed of 2000 kg/hr of hull (21). In the following section the main types of furnaces used are reviewed.

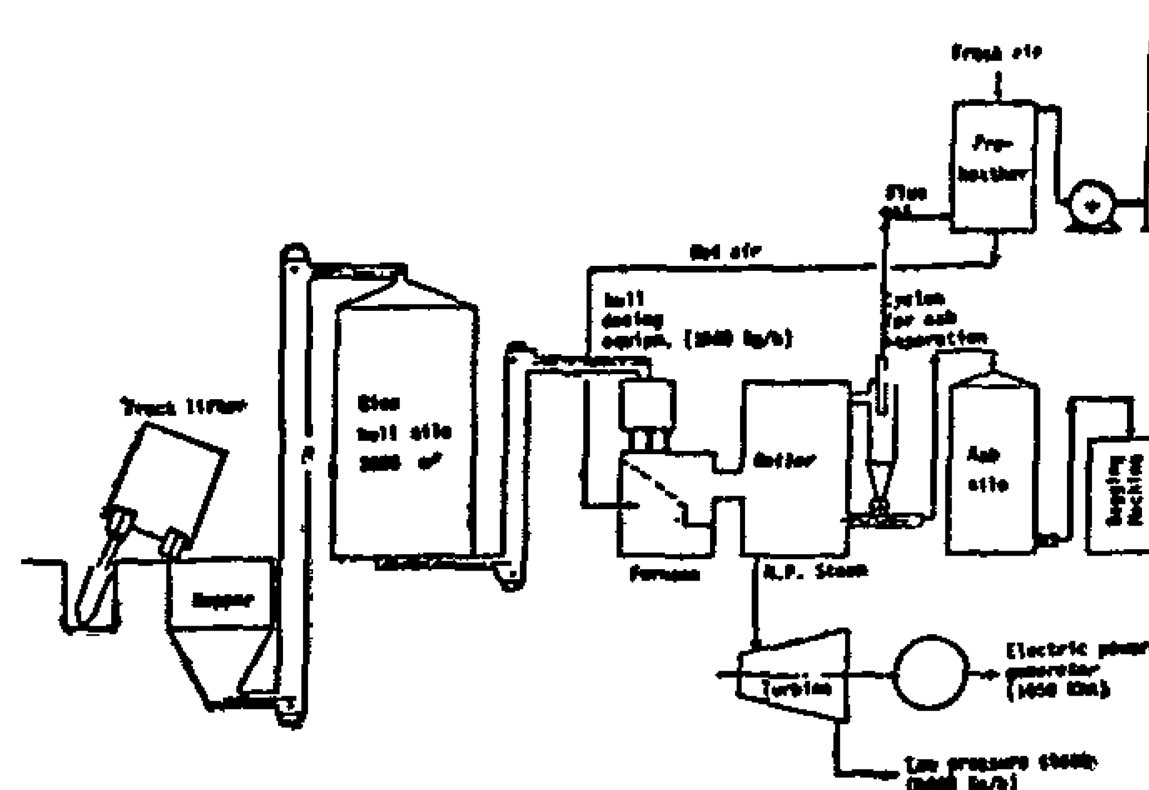


Fig.(2) Rice Hull Combustion Plant (21).

Table (1)
Average Characteristics of Rice Hulls and Straw.

Analysis wt.%	Carbon	Hydrogen	Nitrogen	Oxygen	Ash	Volatile Matter	Calorific Values (kcal/kg)
Rice Hulls	37.69	5.23	0.5	36.58	20	60.2	2985
Rice Straw	38.50	5.30	0.7	37.50	18	63.0	3100

For complete combustion of one kg of such agricultural residues, 5 kg of air are required plus the excess amount which would generally depend on the type of furnace used.

3. ENERGY UTILIZATION METHODS

The methods used to produce energy from biomass can be categorized under thermochemical and biochemical routes. The former usually utilize relatively dry residues and include: direct combustion, pyrolysis, gasification and liquefaction. Biochemical methods normally utilize biomass substrates with moisture contents exceeding 50% and a (C/N) ratio lower than 30% and embody frementation, anaerobic digestion and composting (12).

3.1. Direct Combustion

Direct combustion is the oldest and simplest means for biomass energy utilization. Many investigations have been undertaken in the field of rice hulls and straw combustion (13,14).

3.1.1. Domestic uses

Rice hulls are burned as a domestic fuel in several countries (4). However, no such uses are practiced in Egypt. Different designs for some modified stoves based on the use of rice hulls and straws are used (15-17).

Figure 1 illustrates a step-grate stove developed in India (16). The stove is equipped with an inclined grate at an angle of 45°, which consists of mild steel flats arranged in a stair-case fashion. At the bottom of the inclined grate is a horizontal grate which disposes of the accumulated ash periodically. The hulls are fed into the stove at the top of the inclined grate with the help of a fluted roller placed in the hopper, spread in a thin layer on the steps of the grate and, thereby slides down by gravity while combustion takes place. The air necessary for the combustion is sucked in through the opening for feeding hulls and partly through grate openings. The suction force required for drawing the air inside the stove is produced by the chimney. Efficiency of around 18% was reported (16). The temperature attained was 306°C. For operation with 91.6% excess air, the flue gas analysis showed the presence of 3.5% CO_2, 11% O_2 and no CO. Such type of stoves is extensively used in many Asian countries.

The traditional cooking stoves which are widely used in Bangladesh consist of mud-built cylindrical hole with three raise points which support the cooking utensil (15). These stoves are known to be very inefficient (efficiency being of the order of 10% with some variaton depending on the nature of the fuel and type of the

UTILIZATION OF RICE HULLS AND STRAW AS SOURCE OF ENERGY : A REVIEW PAPER

M.M. El-Halwagi*, M.A. Hamad* and E.M.H. Khater*

ABSTRACT

The present paper undertakes a review of current literature concerning the energy utilization of rice hulls and straw. Different technologies are discussed. These comprise both thermochemical and biochemical processes encompassing: direct combustion, gasification, pyrolysis and fermentation. Prospective energy recovery from rice hulls and straw in Egypt is discussed for both residential and industrial uses.

1. INTRODUCTION

During the past fifteen years, the problems related to the supply and use of energy have been a priority concern for governments around the globe. Nowhere have these problems had a greater impact than in the developing countries (1). In the seventies, unprecedented world energy crisis triggered by the continued rise in oil prices has changed the aspects of global economic balance and has driven almost all the world countries to seek alternative sources of energy. On the other-hand, the recent drop of oil prices has led many countries to review their national energy policies, strategies and programmes with the aim of adjusting them to the new conditions of the energy market, while at the same time trying to maintain a long-term perspective requiring transitional and complex structural changes of their energy systems (2).

Agricultural wastes like rice hulls and straws represent an important part of the renewable biomass resource base that can be utilized as a source of energy in the world. In consequence, the status of rice hulls in particular has undergone a change from a disposal nuisance to that of an important raw material. Mahin (3,4) mentioned that the actual heat content of the rice hulls per unit weight is around 15 MJ/kg, or about 3 kg of rice hulls are equivalent to one kg of fuel oil from the heat content point of view (5,6).

Hamad (6) estimated that Egypt produces about 400000 ton/year rice hulls and 1.5 million tons/year rice straw. Of the estimated 400000 ton/year rice hulls, about 240000 tons are produced in the form of hullerbran and is used totally as animal feed and accordingly are not available for combustion as energy source. The remaining 160 000 tons/year which are produced mainly in the governmental rice mills can be used as an energy source, either inside or outside the mills.

Rice straw is used partially as an animal feed, raw material for paper industry and as fuel for residential uses in rural areas. A substatial portion of the produced straw in Egypt is estimated to be burned in the very low efficiency rural stoves and ovens.

2. CHARACTERISTICS OF RICE HULLS AND STRAW

Many investigators have reviewed the composition and fuel-related characteristics of rice hulls and straw (7-10). Average values as summarized by Beagle are given in Table (1). Egyptian rice hulls and straw also have similar characteristics (5).

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7.2. As far as UF is concerned, inorganic tubular membrane seems to have good potential for wastewater as evidenced from BOD reductions. However, additional work is still needed to investigate separation efficiency under relatively high pressures and with relatively smaller pore size.

7.3. At this level of investigation, resource recovery prospectives seem to be viable from the technical point of view. Although complementary treatment could be excluded, detailed assessment of economics for pilot and industrial scale systems manadate thorough evaluation of high rate AD and UF systems.

ACKNOWLEDGEMENT

The authors wish to thank the staff of the starch and glucose company for providing the samples and for their cooperation. Also, a debt is ackowledged to engineers Asem Ali Adham and Hayam Fahim Shaalan for providing the laboratory assistance needed for his work.

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brane surface to the bulk of the solution on one side and the subsequent building-up of a more concentrated layer of macromolecules in the membrane surface due to higher flux on the other side.

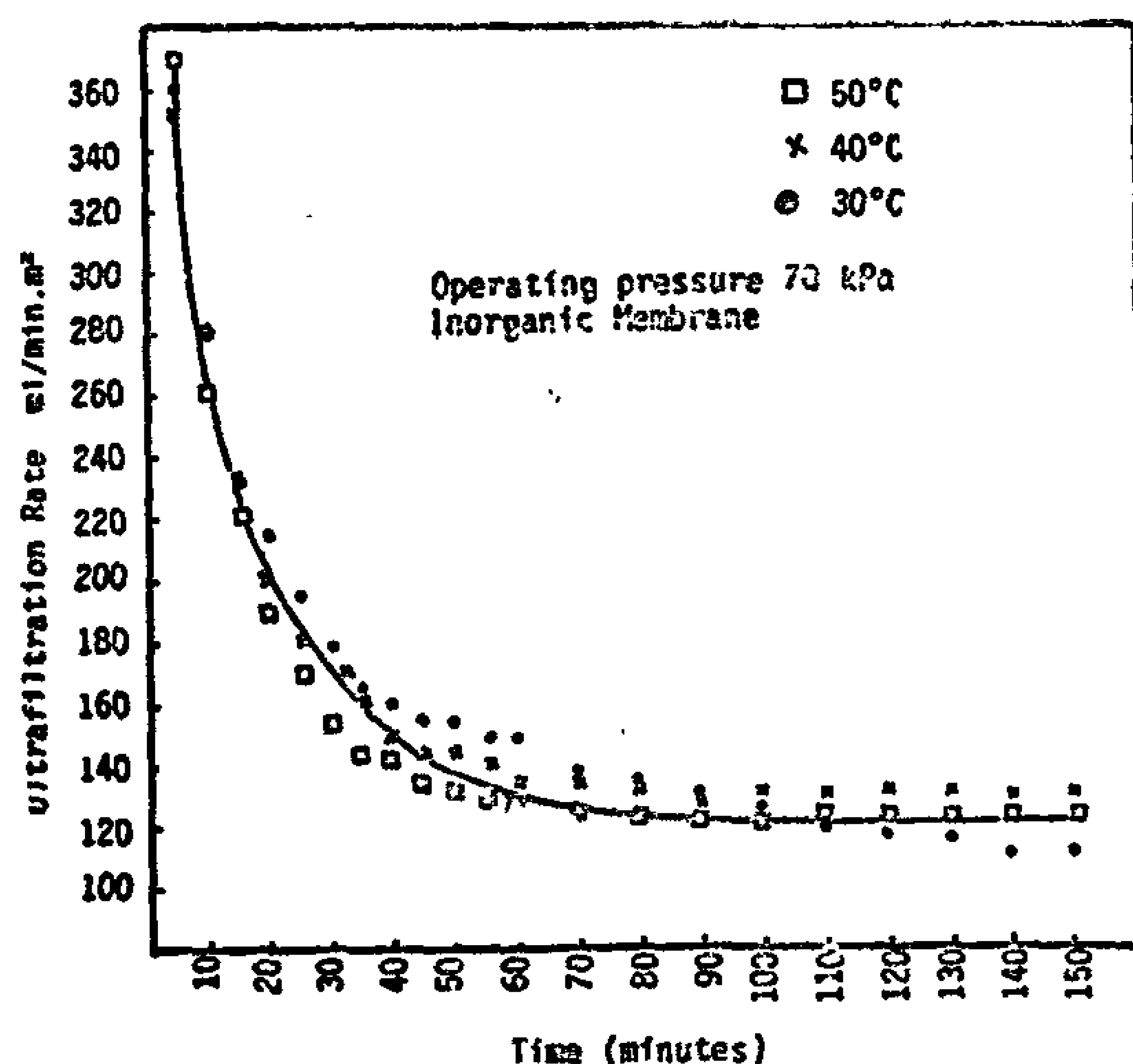


Fig. (8) Effect of temperature on ultrafiltration of clarified wastewater from starch section

The performance characteristics of the three types of membranes are summarised in tables (5) and (6). In terms of pollution abatement and water reuse, the inorganic and cuprophane membranes have shown adequate performance (% BOD reduction). For those membranes, the carbon to nitrogen ratio has increased in the concentrate as compared to the feed indicating a preferential transfer of proteins than carbohydrates through the membrane pores.

Table (5)

Typical Performance Indicators for the Investigated Membranes.

Membrane Module	Ultrafiltrate to feed Concn ratio		C/N			Concentration ratio TS_{conc}/TS_{feed}
	C	N	Feed	Ultrafiltrate	Concentrate	
Inorganic	0.52	0.79	33.5	22	35.5	1.50
Polyacrylnitryl	0.90	0.70	19.0	24	18.0	1.72
Cuprophane	0.64	1.52	20.0	7.3	37.1	1.80

The presence of starch in the ultrafiltrate has been confirmed by iodine test and colorimetric measurements. This indicates that small molecular weight starch such as α -amylose (M.wt 10000) passes through the membrane pores.

VII - Conclusions

7.1. The complex substrate present in efluents of starch plant is suitable for AD. BOD reduction varies from 50-90% depending on the prevailing reaction conditions. It is evident that AD studies could proceed favourably with raw effluents at relatively higher temperature. Investigations are currently undertaken to develop laboratory high rate digester to cope with industrial requirements.

Table (6)

Characteristics of the Ultrafiltrate of Different Members Modules.

Streem	Total solids gm/1	Carbohydrate concentration gm/1	BOD 5 gm/1
Feed	1.80	1.425	800-900
Ultrafiltrate			
— Cuprophane membrane	1.25	0.340	75-200
— Inorganic membrane	1.26	0.300	70-180
— Polyacrylnitryl membrane	1.35	0.375	500-570

It is apparent that the trends of change of cumulative total volume of gas produced with the total variation of solids content of the treated effluents and digester temperature are in agreement with published data[13].

The plateau in curves b and c (figure 6) may be attributed to the intermittent stirring in these experiments. The experiment represented by curve c where the pH has been adjusted when needed gave lowest level of gas production though it extended over a longer period of time (21 days).

As expected, the reaction with initially high rate (curve b) has terminated more rapidly than the slow starting reaction (curve c) when the nutrient is limited. This is also liable to occur when we take into consideration the relatively high C : N ratio of the feed, the possible low phosphate content (phosphate being essential for biogas metabolism), the presence of inhibitory concentrations of sulphate (resulting from biological oxidation of sulphites) and the complexity of the mixed culture and interdependence of its various components.

As shown in table (4), BOD reduction as high as 90% has been achieved, thus proving the technical viability of this approach for the treatment of wastewater from starch industry.

Table (4)
Characteristics of Stream for the Anaerobic Fermentation Experiments.

Stream	TS		BOD_5	
	Unfermented gm/l	Fermented gm/l	Unfermented gm/l	Fermented gm/l
Input to clarifier I	6.1-7.'	4.1-5.2	2400	130-1220
Clarified effluent II	1.8-2.9	1.6-2.0	800-900	400-700

6.2 Ultrafiltration

The time dependence of ultrafiltration rates (UFR) for samples from clarified effluent using the investigated three types of membranes are shown in figure (7).

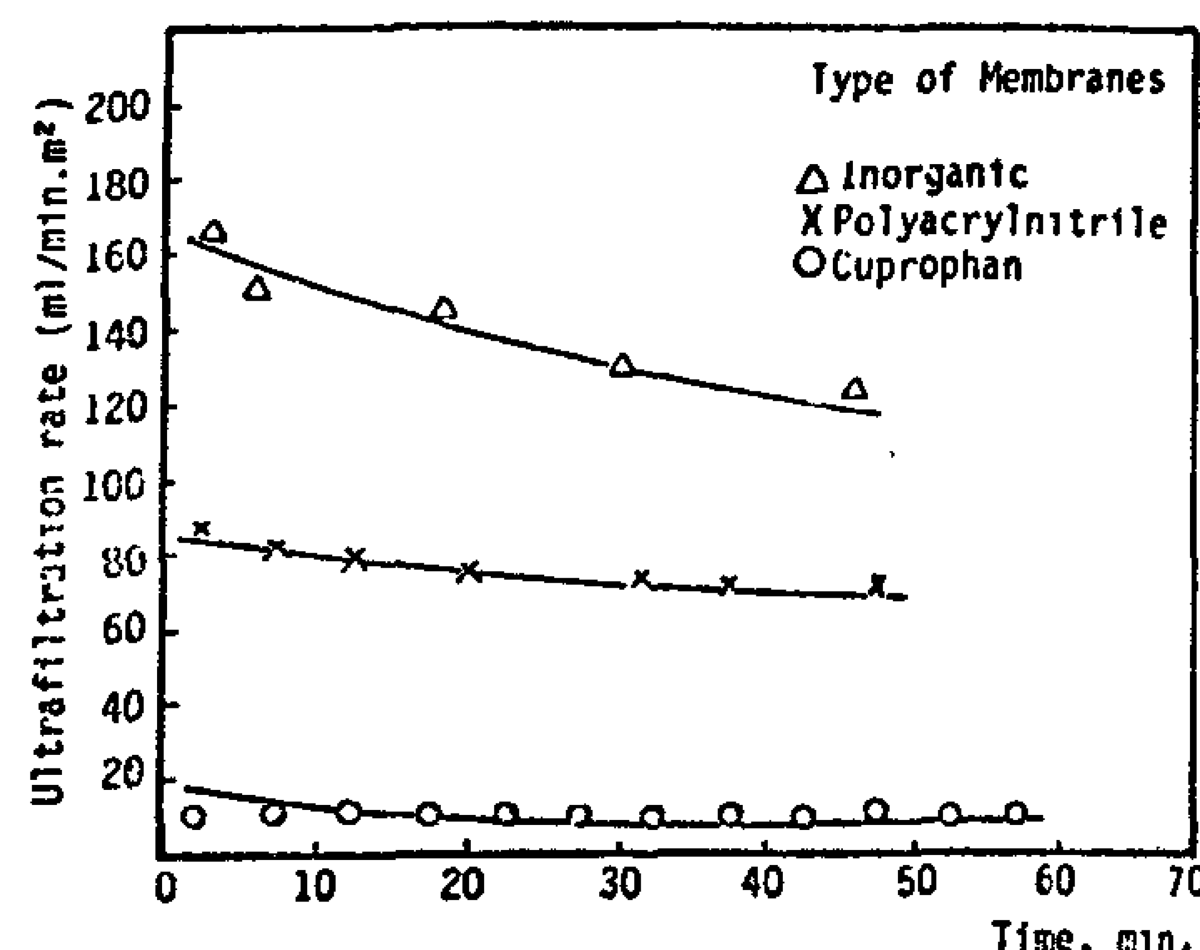


Fig. (7) Ultrafiltration of clarified corn starch wastewater

It is apparent that the inorganic membrane exhibited the highest ultrafiltration rates while cuprophane gave the lowest values. Further, the rate of change of UFR with time is also highest in the case of the inorganic membrane. This may be attributed to the concentration polarization occuring when macromolecules (such as starch and protein) are retained on the membrane surface.

For higher UFR levels, the rate of build-up of gel layer on the membrane surface increases hence causing a more rapid decrease of UFR with time. This result agrees well with reported work of the authors and others (12,13,14) where marked flux decline has taken plae during the UF of macromolecules solutions.

To investigate the effect of temperature on UFR, experiments have been conducted on samples from starch section wastewater using the tubular inorganic membrane within the range of 30-50°C. Results as plotted in figure (8) show insignificant changes due to temperature variation. This may be attributed to the counterbalance between the increase of UFR by virtue of decrease of viscosity and hence increase of transfer of macromolecules from the mem-

5.3. Ultrafiltration Experimental Set-up and Conditions

Samples from input to clarifier have been subjected to low pressure ultrafiltration using three types of membrane modules namely cellulosic hollow fibre, polyacrylnitryl holow fibre and tubular inorganic membrane. The experimental set-up is depicted in figure (4) and the adopted experimental conditions are summarised in table (3).

Table (3)
Summary of Erperiments Conditions of Ultrafiltration.

Membrane Modules :

1. Polyacrylnitryl hollow fibre module (ospal AN 69 HF), membrane area 1.3 m^2.
2. Cuprophane hollow fibre module (prima BL 613 HF) membrane area 1.3 m^2.
3. Inorganic tubular membrane (sfec, Carbosep), membrane area 200 cm^2.
   Clarified wastewater.

Operating pressure: 70 kPa

Temperature :

— Room temperature (22 ± 2°C).
— Other temperature effect studies conduced at 30, 40, 50°C (± 0.5°C) using ultra-thermostat.

Operation Mode:

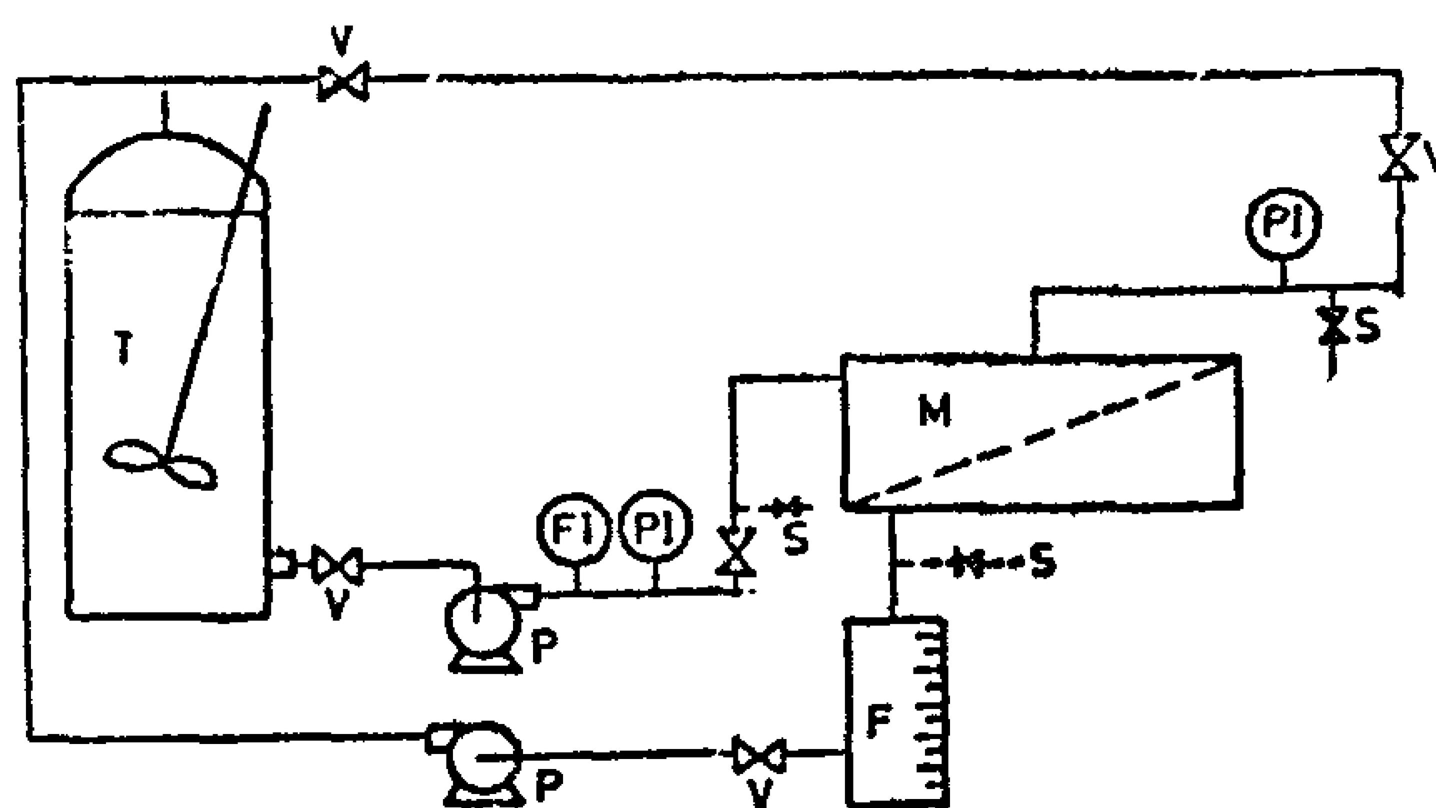
— Batch.

Measurements.

— Ultrafiltration rate.
— BOD5
— Total Carbohydrates.

5.4. Analytical Measuring Techniques

The suspended solids, total solids, and carbon content have been determined gravimetrically. The nitrogen content is obtained using kjeldahl method. BOD has been measureed by a 6 bottle manometric apparatus while the carbohydrate content has been determined colorimetrically[1].



F Filtrate tank
M Ultrafiltration membrane module
PI Pressure indicator
T Solution tank
FI Flow indicator
P Pump
S Sampling line
V Regulating valve

Fig. (4) Experimental Set-up of Ultrafiltration.

VI - RESUTS AND DISCUSSION

6.1 Anaerobic Digestion

Results of the exploratory anaerobic digestion experiments are depicted in figures (5) and (6) and table (4).

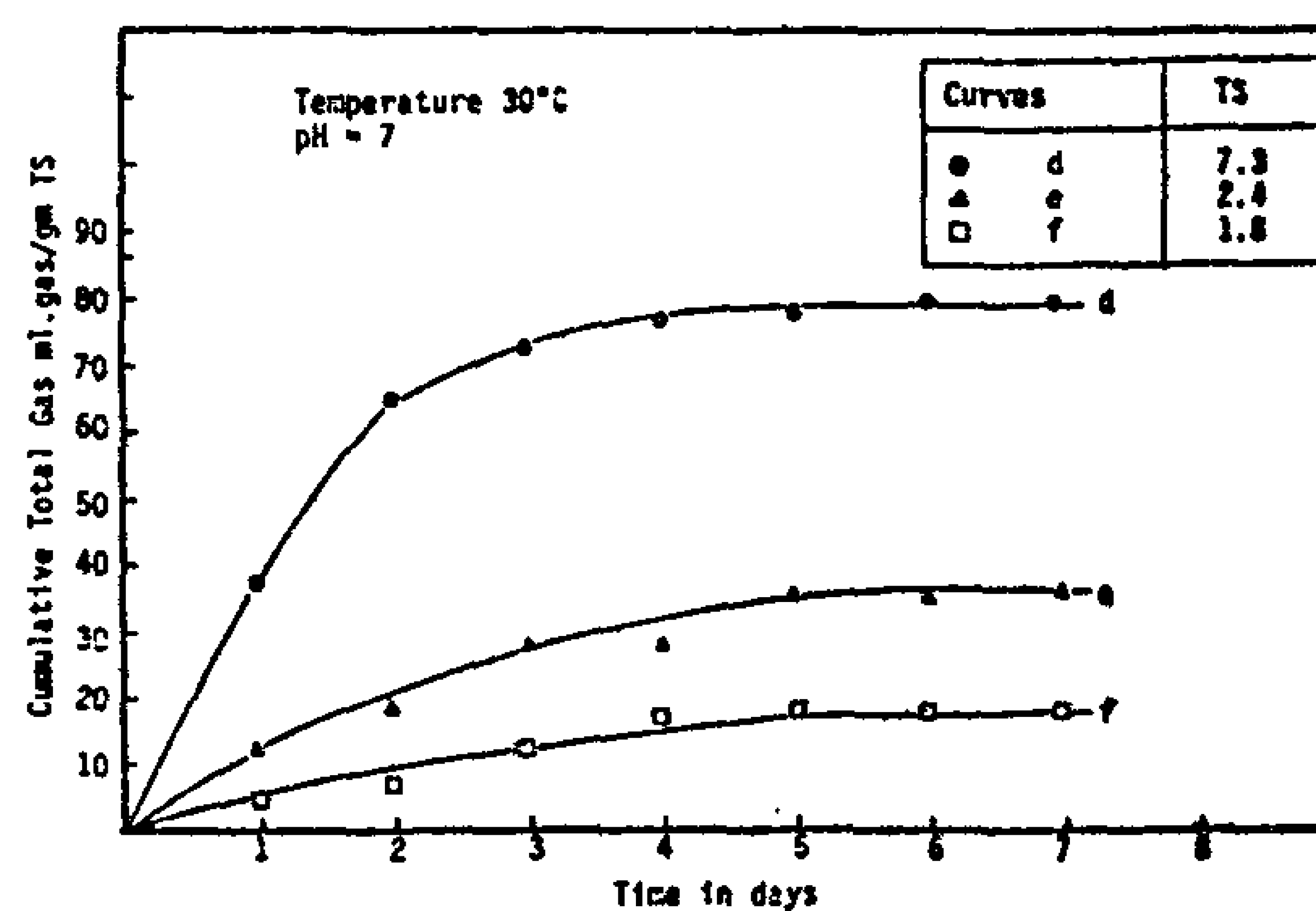


Figure (5) Effect of total solids on gas generation

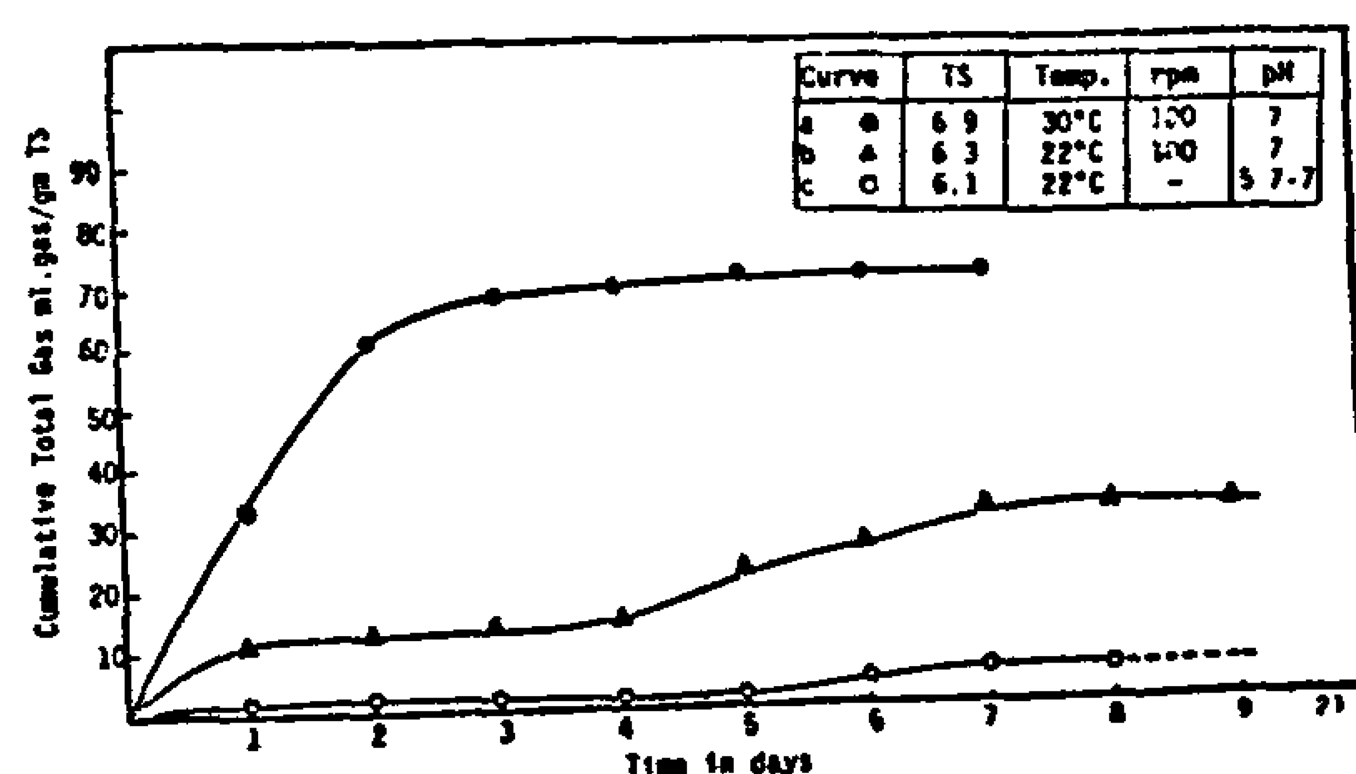


Figure (6) Effect of temperature on gas generation

centration of the stable mineral matter and humus also increase with digestion.

Successful operation of the digester necessitates the control of five major parameters namely temperature, pH, anaerobic conditions, amount of nutrients and toxicity.

4.2. Ultrafiltration

Ultrafiltration is a pressure driven membrane separation process characterised by relatively low pressures (50-800 kPa) as compared to reverse osmosis (3-10 MPa). It is used to effectively separate solutes and macromolecules of molecular weights within the range of 500 to 350000. Progress in membrane material research has led to the production of polymeric membranes with high flux and specific cut-off. Recently, inorganic membranes with excellent chemical and thermal stability have been introduced for commercial applications.

The mechanism of separation of macromolecules by ultrafiltration involves the convective transport of solvent and small molecules through the tortuous passages in the membranes. This leads to the con centration of macromolecules on the membrane surface forming a gel or secondary membrane layer. This layer is responsible for flux decline which is one of the limiting factors in ultrafiltration. This phenomenon is dependent upon the characteristics of both the feed and the membrane system in addition to the prevailing hydrodynamic conditions.

V - MATERIALS AND METHODS

5.1. Characteristics of Treated Effluents

Experimental investigations have been conducted on representative samples from the input to the clarifier and the clarified supernatent effluent. Table (1) presents typical characteristics of the treated samples.

Table (1) Typical Characteristics of Treated Effluents

Item / Effluent	Input to Clarifier (I)	Clarified Effluent (II)
Suspended Solids (SS)(mg/l)	3.4-4.5	0.0-0.2
Total solids (TS)(mg/l)	6.0-7.5	0.3-2.6
pH	4.2-5.2	4.2-5.2
BOD_5 (mg/l)	1800-2500	800-900
Carbon (mg/l)	2400-3000	1200-1600
Nitrogen (mg/l)	100-150	50-100
Carbohydrates (mg/l)	1.8-3.4	0.2-1.2

5.2. Anaerobic Digestion Experimental Set-up and Conditions

Anaerobic treatment of samples from effluents I and II have been conducted in laboratory bench scale digesters. A schematic representation of the experimental set-up is shown in figure (3). The experimental conditions are summarised in table (2).

Table (2)

Experimental Conditions

for the Anaerobic Treatment Experiments

Feed :

-- Input to Clarifier (I) and Clarified Effluent (II).

Fermenter :

-- Laboratory fermenter (Type New Brunswick Scientific, Model 2).

Sample Volume : — 4 litres.

Temperature : -- 20 - 30°C.

pH : -- 4.5 - 7.

Stirring : — Intermittent or Continuous

Duration : — 7 - 21 days.

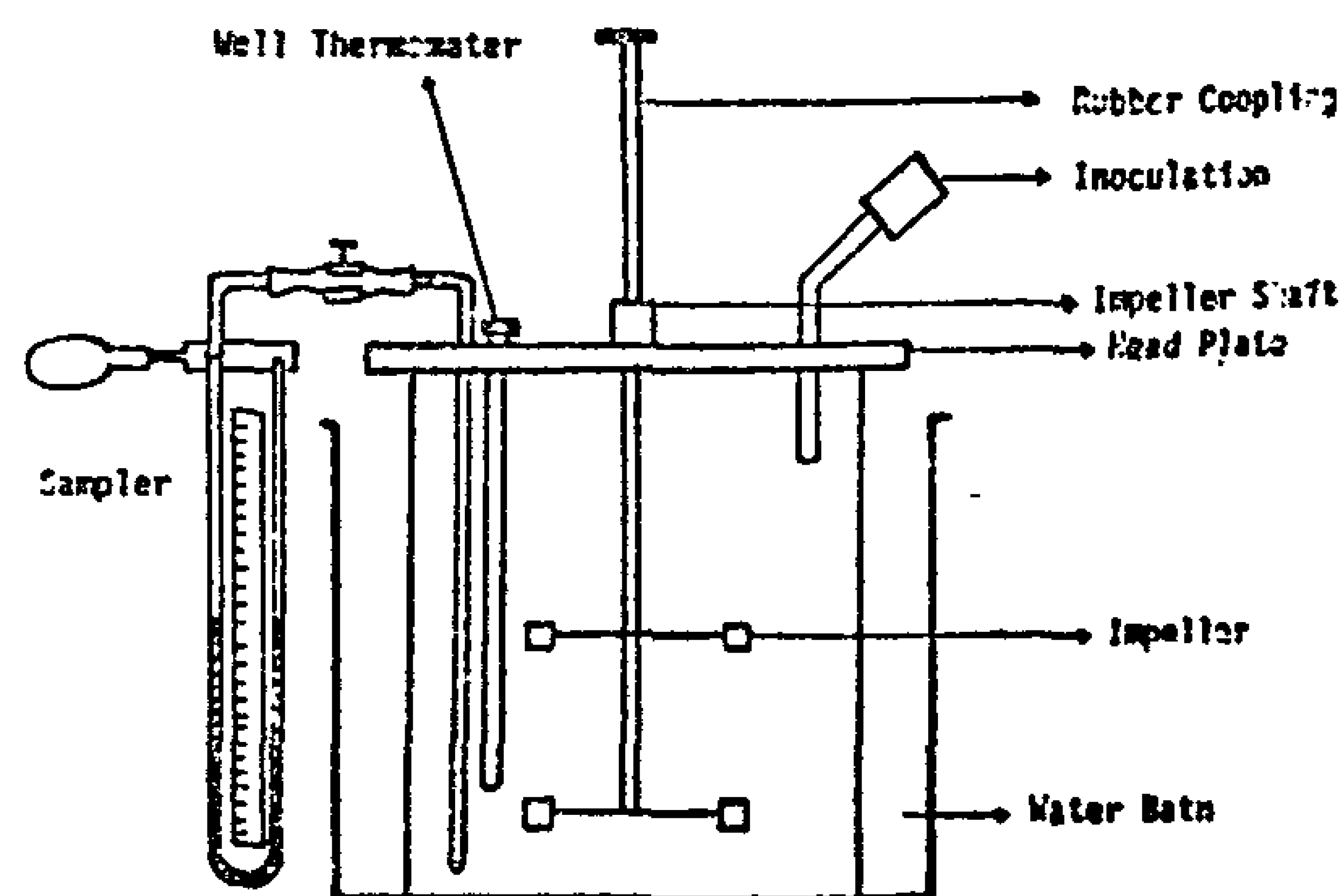


Fig. (3) Schematic Representation of the Experimental Batch Digester.

III—CURRENT TREATMENT TRENDS

Alternative options for the treatment of starch production effluents may be broadly classified into:

1. Simple clarification which was the first treatment approach adopted for the removal of settleable materials. Further improvement was introduced by addition of lime which resulted in a highly clarified effluent[1]. However, the BOD was still at an unsatisfactory level to conform with enforced discharge limits[4].

2. Bottling-up process[5] which comprises reuse of process water, evaporation of some portion of the reused water (primarily steeping water) and addition of the dried residues to the recovered gluten. The method has been developed to the extent that it has been considered as an integral part of the corn starch production. By this process it has been possible to reduce the losses of ground corn from 2.5-3% to less than 0.5% Inspite of the obvious merits of this process, the technology is considered to be rather complex.

3. Biological Processes : Conventional activated sludge and trickling filters have been in practice in numerous production facilities. Reported performance data implies that both methods are generally satisfactory in reducing BOD load[6]. However, trickling filters are considered to be superior because of their flexibility to tolerate load variations.

Anaerobic digestion has been recently adapted by various industrial facilities using high rate digesters[7,8]. A portion of the produced gas is used as a supplementary source of energy.

4. Membrane separation techniques which are finding wide application in wastewater treatment of food industries. Ultrafiltration and reverse osmosis are most commonly used for the purpose. Along with the marked reduction of BOD levels, appreciable product recovery is attained. Separation of protein, starches, complex organic compounds and colloidally dispersed substances by industrial ultrafiltration has been reported[9,10]. Anaerobic digestion and ultrafiltration have been the subject of this exploratory investigation due to their resource recovery potentialities in addition to their pollution abatement prospectives.

IV — BASIC CONSIDERATIONS OF PROPOSED SCHEMES

4.1. Anaerobic Digestion

Anaerobic treatment has proved to be appropriate for the treatment of sludges and food wastes characterised by high organic loads. The principal functional element of the system is the anaerobic digester. Numerous investigations have been successful in identifying the following reactions[11]:

a) Hydrolytic reactions which liquify suspended solids into proteins, carbohydrates and lipids.

(b) Conversion of proteins, carbohydrates and lipids into amino acids, sugars and fatty acids.

c) Production of acetic acid and hydrogen partially through the intermediate formation of other shorter chain fatty acids.

d) Conversion of hydrogen and fatty acids to methane.

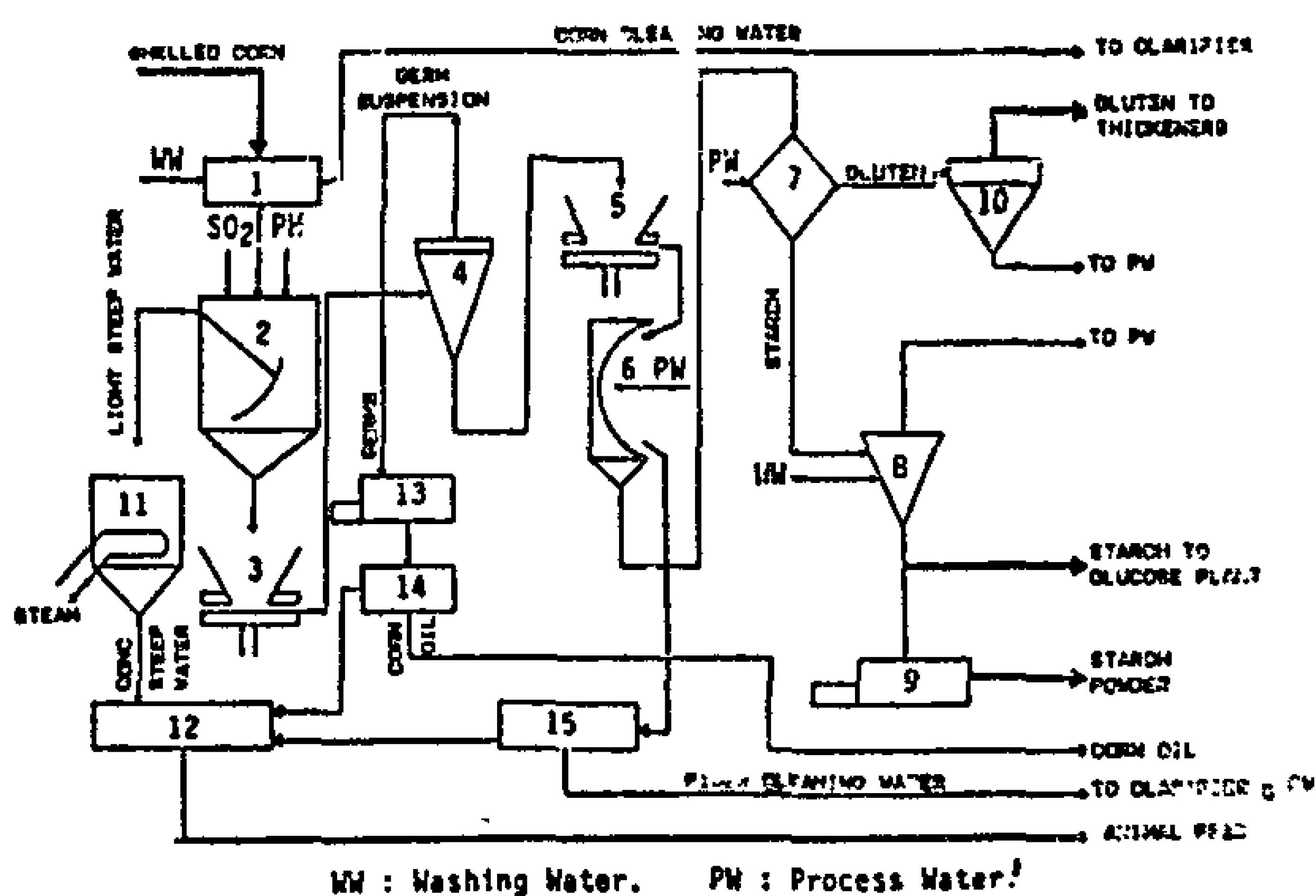
Approximately 30% of methane is produced from hydrogen gas by a large number of anaerobic bacterial species while about 70% is produced from acetic acid by only two identifiable bacterial species. Both groups are referred to as methanogenic bacteria. Both the liquifying and gasifying stages must operate simultaneously at an equivalent rate. If the liquid product accumulates, it may inhibit the gasification stage.

The BOD initially increases through solubilization of suspended solids then decreases as gasification proceeds. The con-

This paper attempts to investigate the potentialties for the application of these technologies for the effiuents from the starch production plant at Mostorod, Cairo.

II — BRIEF DESCRIPTION OF THE STARCH PRODUCTION PLANT

The starch production industry by the wet milling process as applied world wide relies mainly on a sequence of milling operations which separate the corn kernel into its basic components; namely starch, germ, gluten and hull(2,3,4). Figure (1) schematically represents the basic processing stages of the plant at Mostorod. Imported corn is first cleaned then steeped for 72 hours in circulating warm dilute sulphurous acid solution (0.3-0.4%) to loosen the hull and dissolve minerals.

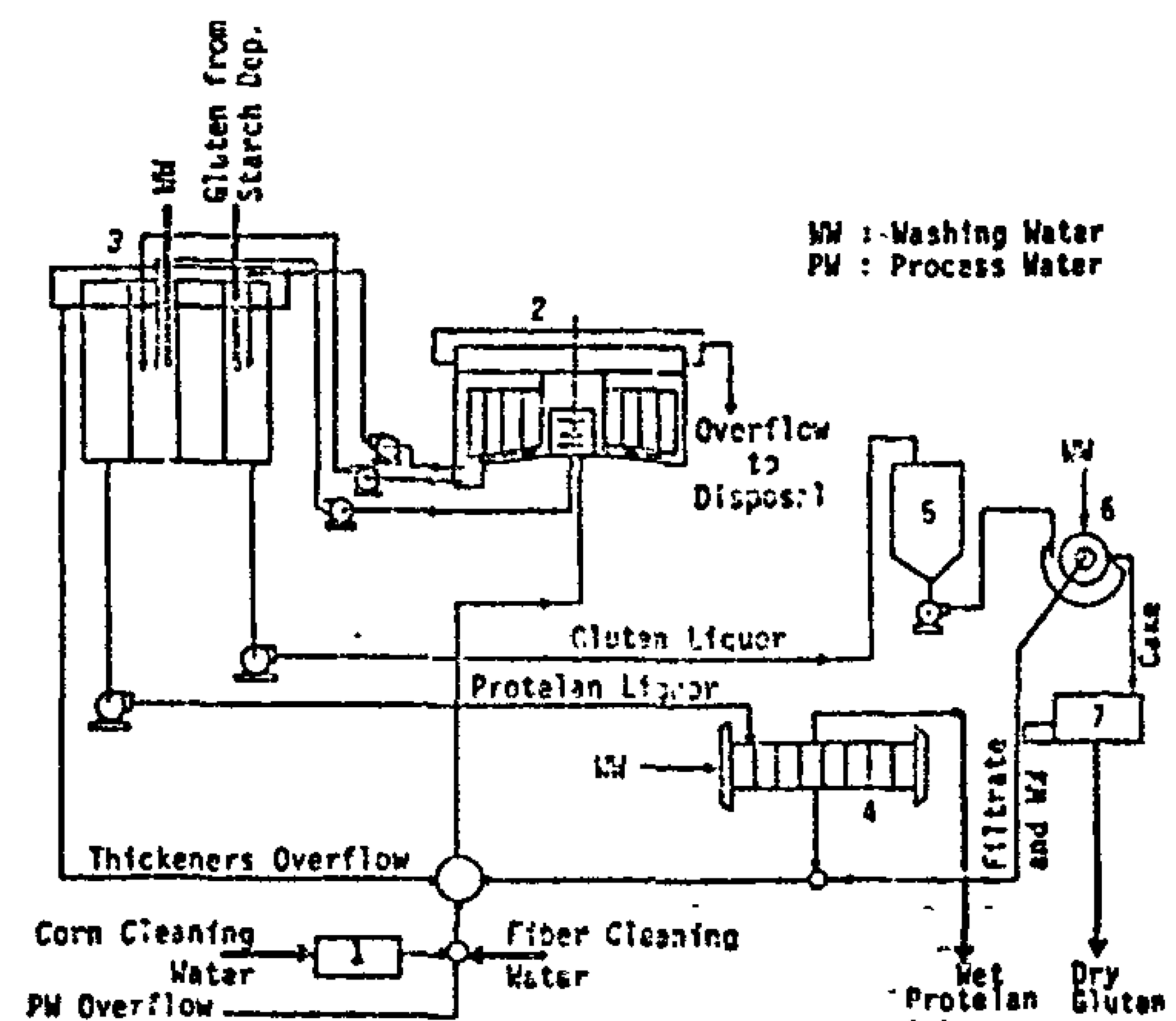


1 Corn Cleaners
2 Steep Tanks
3 Degerminator Mills
4 Germ Separators
5 Fiber Grinding Mills
6 Fiber Washing Jet Screen
7 Starch Gluten Centrifugal Separators
8 Starch Centrifuge
9 Starch Dryers
10 Gluten Centrifuge
11 Steep Water Evaporators
12 Animal Feeds Receivers
13 Germ Dryers
14 Oil Extractors
15 Fiber Cleaners

Fig. (1) Schematic Representation of the Corn Wet Milling Process.

The cleaned softened kernels are then ground to tear the kernels into coarse particles and free the rubbery oil bearing germ without crushing it. The liberated germ is separated by flotation while the kernel residues are subjected to fine grinding and washing through a series of screens to remove the hull from the starch and gluten. The hull is then combined with the protein steep water to give corn gluten feed. The remaining suspension of gluten starch is subjected to centrifugation and subsquent flotation to separate the relatively heavier starch solution from the lighter gluten. The latter is directed to the byproducts recovery section while the starch solution is further concentrated and dried to produce native starch or hydrolysed to produce glucose.

The wastewater from the various processing sections containing mainly hulls, fibres and corn dust are transferred to the byproducts recovery section. This comprises sedimentation basins, a clarifier and sets of filter presses and rotary filters. Two types of animal feed namely protilan and gluten are recovered. A schematic representation of the byproducts recovery section is shown in figure (2).



1 Strainer 2 Clarifier
3 Gluten-Protelan Thickeners
4 Protelan Filter Press
5 Gluten Liquor Tank
6 Gluten Vacuum Filters
7 Gluten Dryers

Fig. (2) Schamtic Representation of the Byproducts Recovery Section.

THEORETICAL AND EXPERIMENTAL INVESTIGATION OF TREATMENT OF EFFLUENTS FROM STARCH AND GLUCOSE INDUSTRY

By

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ABSTRACT

Liquid waste generated in starch and glucose industry is characterised by relatively high solid content and Biochemical Oxygen Demand (BOD). Currently, waste water treatment is limited to the separation of the suspended matter that is subsequently used as cattle fodder.

The current paper aims at exploring the technical feasibility of processing effluents from starch plant via Anaerobic digestion (AD) and Membrane Ultrafiltration (UF). Those have been chosen for their prospective potentialties for resource recovery in addition to considerable reduction of BOD loads. AD studies have been performed on laboratory scale batch digesters for raw and clarified effluents. Membrane UF has been applied using hollow fibers and tubular inorganic membranes. In both AD and UF systems, BOD reduction has been taken as the primary criterion of technical feasibility.

The results of the exploratory phase confirmed the primary technical feasibility of the two proposed systems. BOD reduction ranged from 50% to 90% and from 37% to 92% for AD and UF respectively.

Economic considerations mandate investigations of high rate digestion as well as high pressure UF with inorganic tubular membranes.

I — INTRODUCTION

Awareness of adverse environmental impact of effluents from starch and glucose industry rose since the early beginning of this century[1]. These effluents are characterised by elevated biochemical oxygen demand (BOD) levels due to its high content of starch, protein in addition to corn dust and fibres. The approach for alleviating this problem has relied principally on maximising the recovery of byproducts, optimising water use and minimising pollution loads of treated effluents.

In view of the current stringent regulations for pollution control and recent technological advance in starch industries, it was deemed necessary to develop integrated schemes which ensure almost complete recovery of byproducts as well as minimising BOD level of disposed effluents.

Of the numerous available treatment technologies, anaerobic fermentation and membrane separation are currently receiving worldwide interest. Direct application of anaerobic digestion not only reduces BOD but also converts a significant fraction of the organic waste to biogas which is rich in methane and could be used as a source of energy. On the other hand, modern membrane systems permit the appreciable recovery of the byproducts in their original form.

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This will increase the moisture content of the flue gases from 0.1115 to 0.1379 kg.water/kg dry gas.

Capital and Operating Costs

1. The capital investment has been calculated taking into consideration that the scrubber and the make-up tank will be fabricated in the country. The prices of materials and labor costs are those prevailing in the local market at 1986. The results of calculation were as follows:

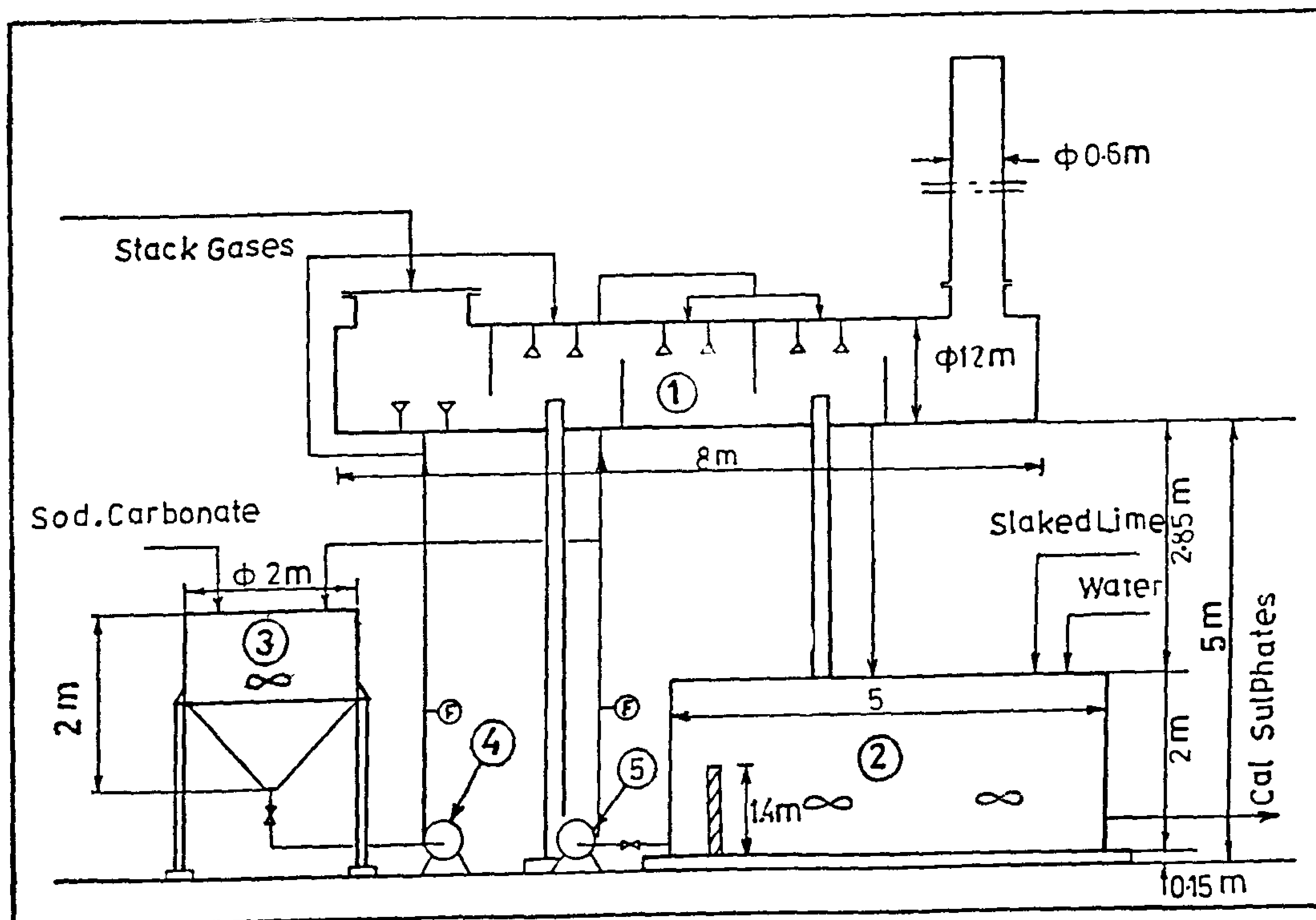


Fig. (6) Process flow diagram of the dual alkali desulphurization method.

1. Scrubber, 2. Reactivation tank, 3. Make up Tank 4,6. Pumps

Table (V)

Capital cost of the proposed unit.

Item	Cost L.E.
1. Metalic works	
1.1. Materials	19360
1.2. Fabrication	4930
2. Electric works	1120
3. Civil works	4000
4. Installation	3100
5. Auxiliaries	2900
6. Painting	300
Total capital investment	35700

2. The operating costs will mainly consist of the price of both quantities is about 29750 L.E. per year.

CONCLUSION

It was seen that the removal of sulphur dioxide emitted in the stack gases of a clay brick factory can be done by a simple flue gas desulphurization unit. The capital cost is reasonable provided that the scrubber, tanks and piping are fabricated locally. The operating costs has been minimized by use of cheap chemicals such as calcium hydroxide and about 5% of sodium carbonate.

It is clear that, with any degree of dilution which may happen in the area of the factory, the level of sulphur dioxide concentration may remain higher than that permitted.

Estimation of the required amount of calcium hydroxide and sodium carbonate:

As mentioned before, the dual alkali process is the most optimum one and it is proposed for the case under study. The amounts of chemicals required has been calculated according to the reactions shown before and they are as follows:

Temperature in the kiln °C	700	900	1000
Calcium hydroxide T/year	619.6	690.5	949.0
Sodium carbonate T/year	31.0	34.5	47.5

Selection and sizing of equipment

1. The selection of equipment depends on the process proposed. As mentioned before the process depends on the use of a solution of an absorpent mainly consists of sodium sulphites and sodium carbonate. This means that insoluble products are not formed in the system and this reduces plugging and scale formation. As shown in Fig. (6), the stack gases is passed through scrubber(1). The scrubber consists of a cylinder, horizontally installed. It is equiped with baffles to regulate the flow of gases and absorpent solution, as well as with sprayers for injection of the absorpent solution. The latter is recycled, it flows back to the reactivation tank(2). This tank is equiped with agitators, calcium hydroxide and water are added and the precipitated calcium sulphites and sulphates are withdrawn and thrown away. Only soluble sodium sulphites, bisulphites and sodium carbonate are pumped back by pump 5 to the sprayers. Make-up sodium crbonate is prepared in tank(3) and pumped to the sprayers in the first and second sections. The feed to this tank consists of the recycled solution, sodium carbonate and water and it is equiped also with an agitator.

2. The sizing of the above equipment depends on detailed calculation of the suitable velocity of the stack gases in the scrubber and the contact time between the gases and the absorpent solution. The calculation of the capacities of pumps, the make-up tank and the reactivation tank has been made taking into consideration the percent concentration of absorpent solution, the amount of active chemicals consumed and the amount of water evaporated. The water evaporated is calculated taking into consideration the heat of reaction of sulphur dioxide with the absorpent, the cooling of the flue gases from 123°C to 75°C. The amount of water evaporated was calculated as follows: —

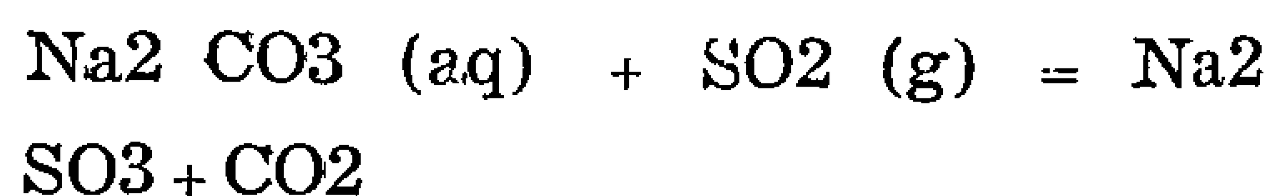
Basis of clculation

1. The composition of the flue gas in kg/hr, the specific heats of different components, within a range of temperature 125-75°C, are shown in Table (IV).

Table (IV)
Flue gas composition and the specific heats of the components.

Gas	N_2	O_2	CO_2	H_2O	NO	SO_2
Content, kg/hr	16498	1010	3949	2407	6.77	126.4
Specific heats Cal/°K.g.mole	0.245	0.219	0.226	0.47	0.234	0.149

2. The heat of reaction evolved will be calculated according to the following representative reaction:



Na2 CO3 (aq) + SO2 (g) = Na2 SO3 + CO2

Net heat evolved = -11.36 kcal/g.mole Na2SO3

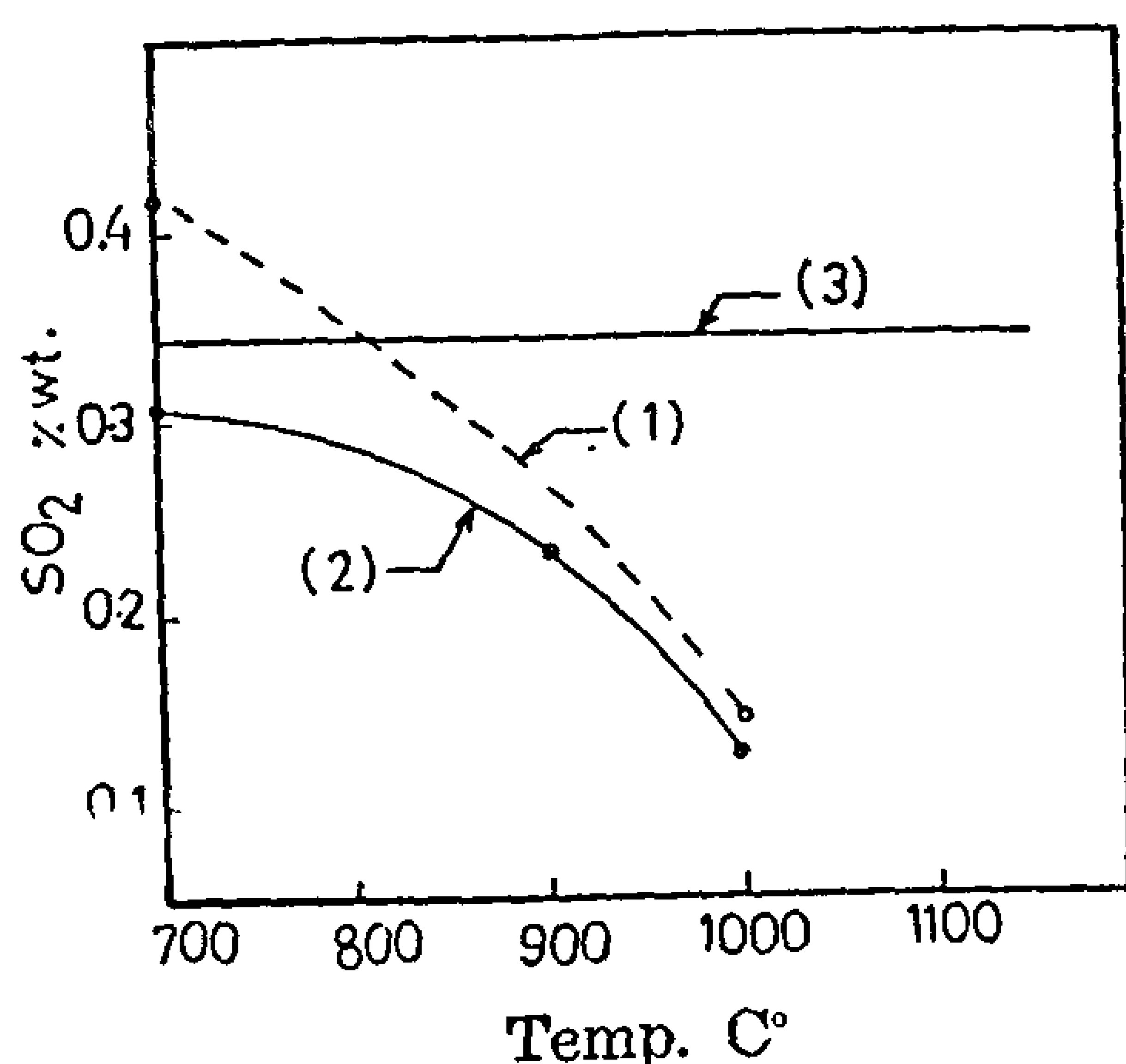
According to the above basis, the sensible heat lost by stack gases equals -303134 kcal/hr, and the heat evolved due to reaction is approximately equal to -22436 kcal/hr.

Total heat which must be removed from the system = - 325570 kcal/hr.

The latent heat of evaporation of water = 539 kcal/kg.

The amount of water evaporated 600 kg/hr.

The decrease of the total sulphur in the clay bricks burned in a laboratory furnace, i.e., in absence of sulphur dioxide is shown in Fig. (4), curve (2). The total percent sulphur (calculated as sulphur dioxide) in the clay bricks burned in the factory kiln is shown in the same figure, curve (1). It may be noticed that the residual sulphur in this case is slightly higher than that in case of burning the bricks in a laboratory furnace. This means that adsorption of sulphur dioxide either physical or chemical by the clay bricks occurs in the factory kiln. This may lead to the increase of sulphates and other sulphur compounds especially at low temperatures.



1. Residual sulphur in the clay bricks burned in the factory kiln in presence of sulphur dioxide.
2. Residual sulphur in the clay bricks burned in a lab furnace.
3. Total sulphur content in a dry unburned clay bricks.

Fig. (4) Decrease of sulphur content in clay bricks

Estimation of the sulphur dioxide in the stack gases in relation with the temperature:

Basis of estimation:

1. Amount of gas oil burned = 1000 kg/hr.

2. Sulphur content of the gas oil = 2% wt.

3. Ratio of gas oil to the amount of stack gases is 1:24 by weight. At this ratio, complete burning of gas oil is noticed.

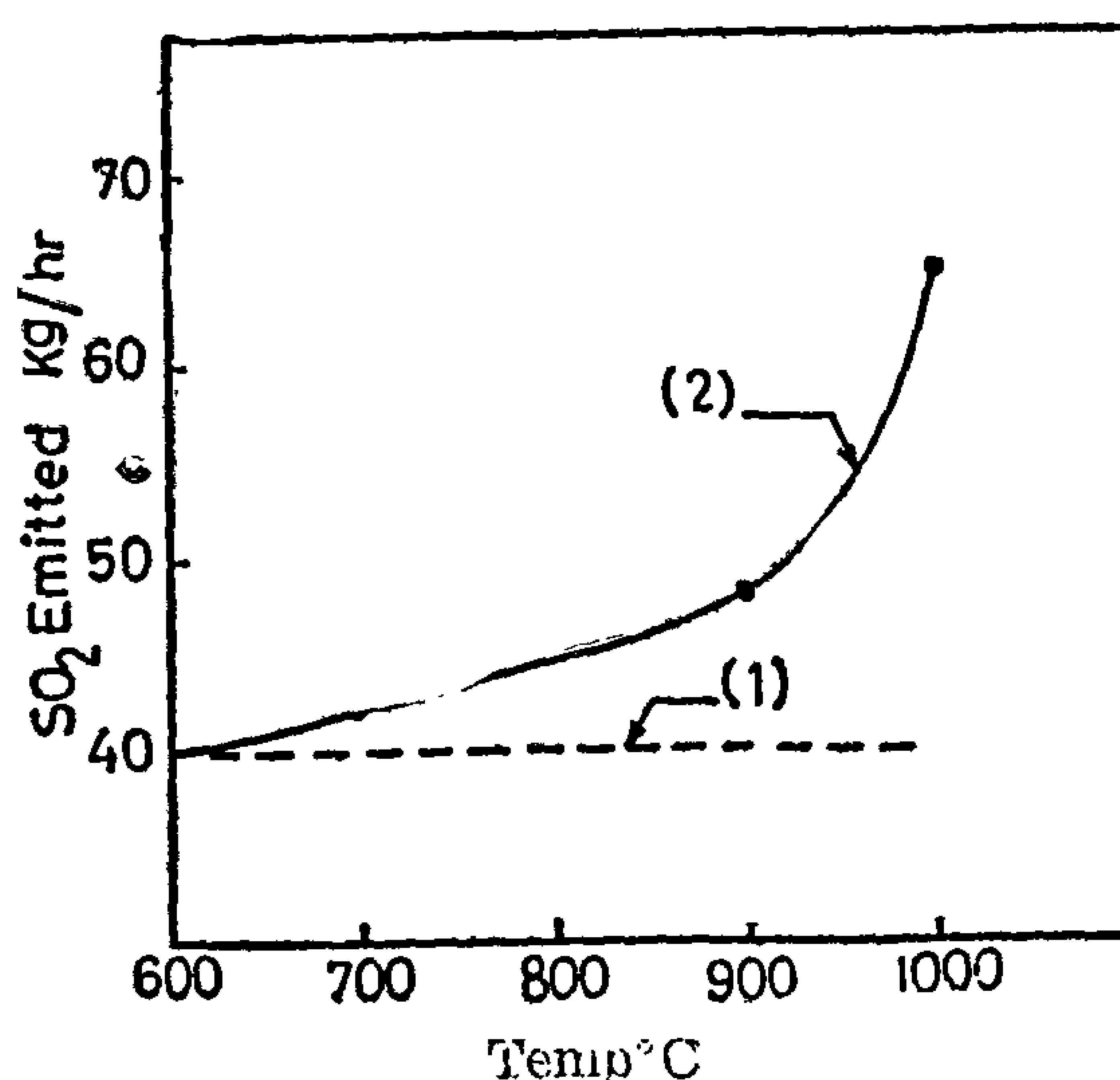
According to the above basis the amount of the total sulphur dioxide emitted in realtion with the temperature of the kiln will be as shown in Table III.

Table (III)

SO_2 emitted in stack gases in relation with temperature.

Temperature in the kiln °C	700	900	1000
Amount of sulphur dioxide emitted, kg/hr.	42.53	47.4	65.11
Sulphur dioxide emission in the stack gases, % wt	0.1772	0.1975	0.2714

The above results are shown in Fig. (5). It is clear that the amount of S02 emission in the stack gases increases with the increase of temperature in the kiln, but this also means a reduction, of the sulphates and other sulphur compounds in the burned clay bricks. To compare the above sulphur dioxide emission in the stack gases with that recommended by the U.S. standards (see the introduction), it is required to convert the percent by wt. to ug/m3 and PPM. These are as follows:



1. S02 emission due to burning of gas-oil
2. Total S02 emission.

Fig. (5) Sulphur dioxide emission in the atmosphere with the flue gases

Temperature in the kiln °C	700	900	1000
SO_2 % wt	0.1772	0.1975	0.2714
SO_2 μg/m³	1.92×10^6	2.14×10^6	2.94×10^6
SO_2 PPM	1772	1975	2714

The above proposed process is shown in Fig. (3). The flue gas passes through the scrubber. The temperature of the flue gases drops to about 60-70°C. The absorpent solution is injected through the sprayers and it flows back to the reactivation tank, calcium oxide (as slaked lime) is added in the reactivation tank to regene at: th: bisulphites and sulphates. Make-up sodium alkali (mainly) sod. carbonate) is made in the make-up sodium alkali (mainly sod. carbonate) is made in the make-up tank.

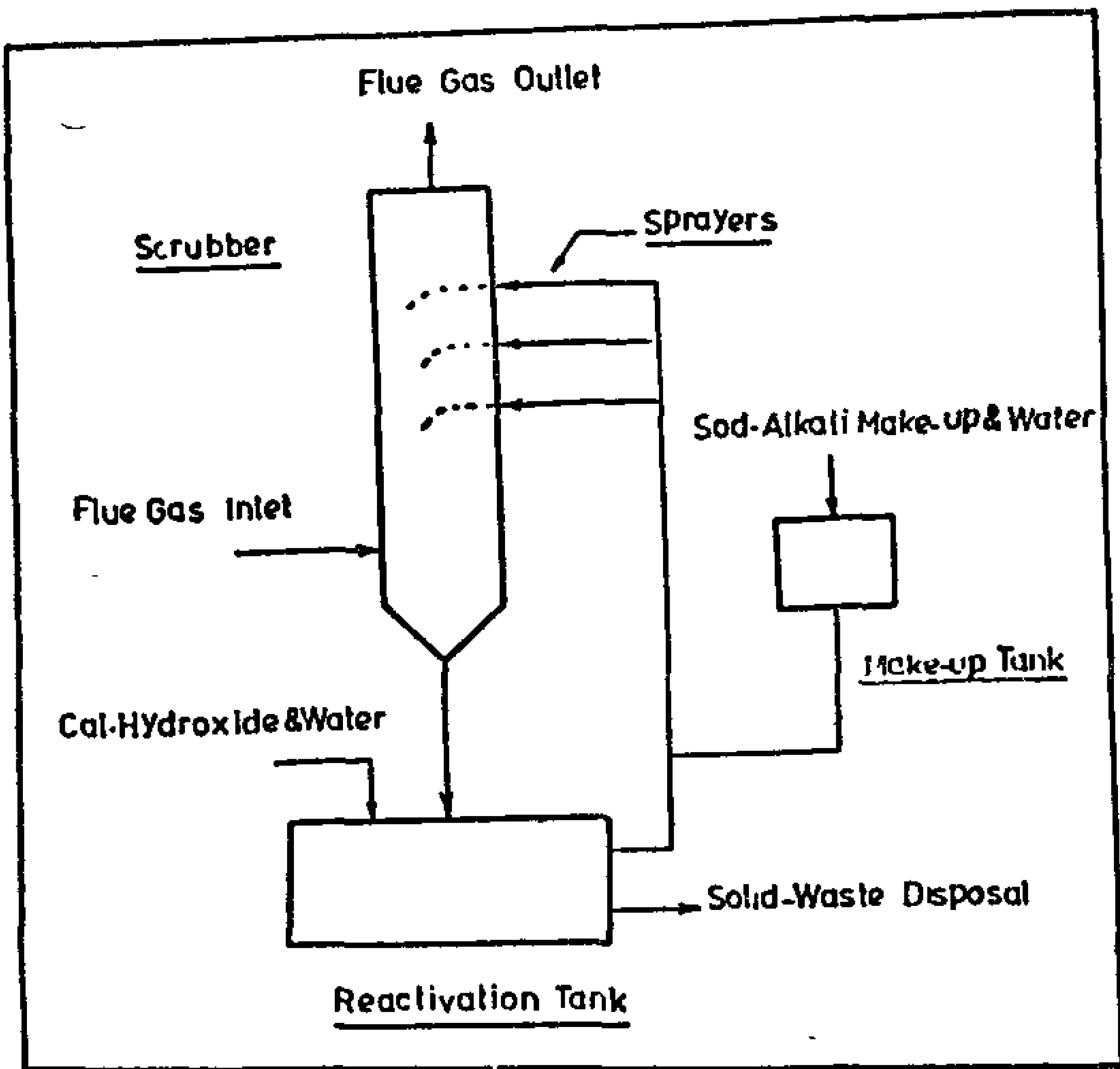


Fig. (3) The proposed wet-absorption process.

Further work is intended to develop the above proposed process or, in other words, it is necessary to determine such parameters as the rate and the quantity of the sulphur dioxide emission, material and energy balancies, selection and sizing of equipment and capital and operating costs.

Development of the Process

Determination of the sulphur dioxide emission in the stack gases:

The sulphur dioxide emission in the flue gases may be due to the thermal decomposition of any sulphur compounds naturally associated with the clay or due to the sulphur compounds present in the fuel or gas oil used in burning the clay bricks. The sulphur dioxide emission due to burning gas oil is calculated on the basis that the percent total sulphur in the gas oil equal two percent by weight (according to Egyptian Standards of Petroleum Products).

The sulphur dioxide emission due to the presence of sulphur compounds in the clay material has been determined by conducting the following programme of experiments and analysis:

1. Analysis of dry clay bricks before burning.

2. Analysis of a smaple of ready-made clay bricks, i.e., after complete burning in the factory kilns at a temperature of 700°C. This sample was refired in a laboratory furnace at 1000°C and the total residual sulphur was determined.

3. Several samples of the same dry clay bricks has been burnt in laboratory furnace at temperatures 700°C, 900°C and 1000°C, and the total residual sulphur has been determined.

The results of these analysis are shown in Tables (1 & 2) and Fig. (4).

Table (1)
Residual total sulphur in the samples of the tested clay bricks

Sample	Total sulphur S % wt.	Total sulphur as SO_2 % wt.
1. Dry clay bricks before burning	0.1745	0.349
2. The same above sample after burning at 700°C in the factory kilns	0.2088	0.4176
3. Re-burning of samples mentioned at 2. in a laboratory furnace at 1000°C	0.072	0.144

Table (II)
Residual SO2 % wt in samples burned at lab. furnace at different temperatures

Sample	Temperature in the kiln °C	SO_2 % wt. 700	900	1000
Sample of dry bricks (the same as that in 1 table I)		0.304	0.232	0.126

nature of the region is such that the land surface is not even but it is of variable levels as shown in Fig. (2). This means that an additional height of about 20-30 meters is required to compensate the difference in the level of the land surface. This represents an additional cost approximately about 30% of the normal cost.

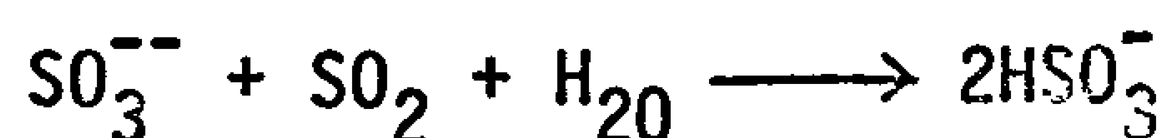
Contours, Precies and Unsurveyed,
Wedis,
Geodetic and triaggulation Points,
Lakes and March
Bensh Marks
Fastory site

Fig. (2) Effect of factory site on the selection of the desulphurization method

The proposed FGD method is a wet dual alkali absorption process(4). In the operation as a whole, lime is consumed to produce a wet solid waste (mainly calcium sulfite/sulfate). Also, a small amount of sodium alkali make-up is required. This is clear from the following illustration:

As the absorption process proceeds, a solution of sodium sulphite/bisulphite and sulphate is formed as a result of the reaction between the sulphur dioxide and the sodium alkali make-up. This solution will absorb S02 from the flue gas or other waste gases. Only the sulphite is active in absorbing S02, forming bisulphite.

Absorption

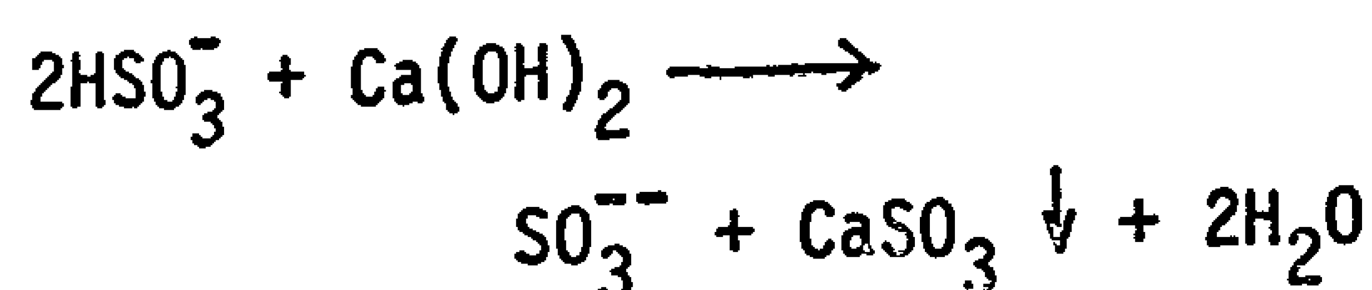


$$SO_3^{--} + SO_2 + H_{2}0 \longrightarrow 2HSO_3^{-}$$

The bisulphite-rich liquor, treated with lime in a reactivation tank, regenerates active alkali for recycle to the scrubber.

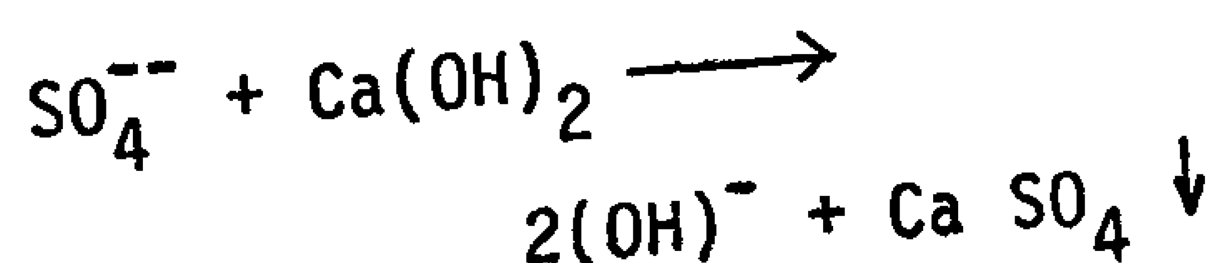
Regeneration

a) Regeneration of bisulphites



$$2HSO_3^{-} + Ca(OH)_2 \longrightarrow SO_3^{--} + CaSO_3 \downarrow + 2H_2O$$

b) Regeneration of sulphates



$$SO_4^{--} + Ca(OH)_2 \longrightarrow 2(OH)^{-} + Ca\ SO_4 \downarrow$$

stagnent weather and as sulphur dioxide is heavier than air, a dangerous situation is not avoidable.

The use of sulphur free-fuels is limited by the cost of desulphurization of petroleum products. Uptill now, in Egypt, such fuels are not produced. In the United States, the prices of treated fuel oils, i.e., free of sulphur is about 20 cent/gallon more than that ordinary fuel oils, this means about 55-60 dollars per ton(4.5).

The use of the relatively flue gas desulphurization methods (FGD) is the most convenient way for removal of sulphur dioxide and gives the solution for regions such as Great Cairo Region. They are either dry or wet methods using a relatively cheap chemicals such as CaO, $CaCo_3$ and dolomite to absorb the sulphur dioxide gas. Such methods can also be used, in a combined process, to remove susbended matters and ashes.

The selection of any one of the above three ways depends on many factors. Certainly the specific factors of any individual case, will play a great role in any selection that have to be done.

Status of the Problem

The case studied in the present investigation is the clay bricks factory located in Sadat City. A lot of sulphur dioxide is emitted from this factory and as a result, the vegetation in the near areas has been burnt-off and the people working in the factory as well as those working in neighbour projects has strongly sufferd from the pollution of the atmosphere due to sulphur dioxide emission °A Flue Gas Desulphurization unit was proposed to reduce the sulphur dioxide emission. The specific factors which favour the use of FGD unit can be summarized as follows:

1. Design considerations: as shown in Fig. (1) the design of the chamber of burning the clay bricks is such that the air required for fuel combustion is not mixed with the air used for drying the wet clay bricks. In other words, the burning chamber is similar to a boiler and the flue gases carring the sulphur dioxide is a limited amount and can be worked up as scrubber. Another less important design figure is that the flue gases are sucked by two suction fans and not flowing by natural draft, i.e., if a Flue Gas Desulphurization unit is used, it will not be necessary to install new fans. Moreover the existing stacks are made of stainless steel and are very low (short stacks). The best use of these stacks is in combination with a FGD unit.

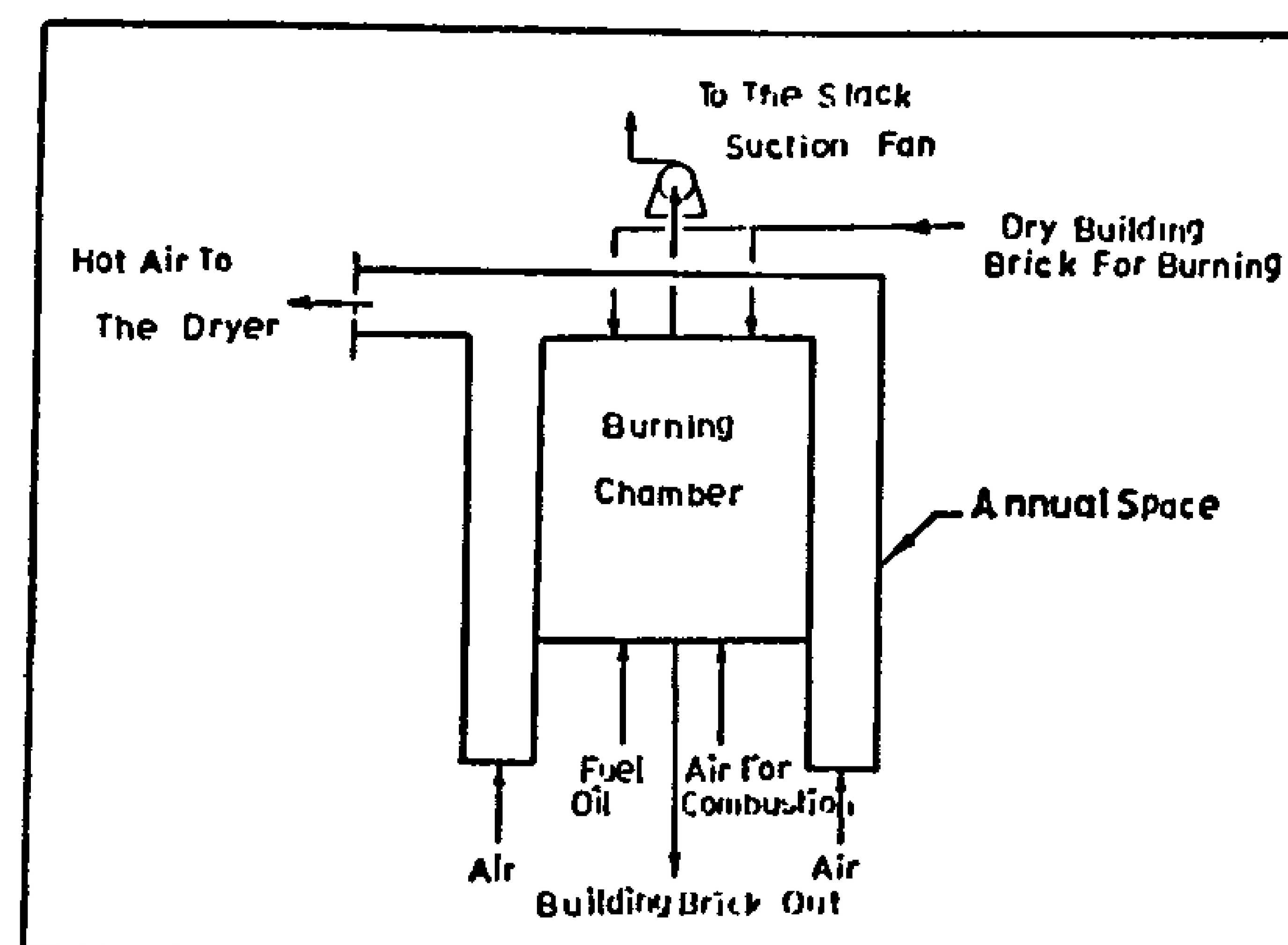


Fig. (1) Plan of the burning chamber and the annual space for preheating air

2. Site considerations: The factory is located in the north from the famous desert autostrade Misr-Alexandria, a place which will be crowded with many vital and important projects in the near future. The use of ordinary brick cheminy will not be of value. Also the topographic

DESULPHURIZATION OF CLAY BRICKS STACK GASES

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ABSTRACT

The aim of the present investigation was to control the sulphur dioxide emission from the stack gases of clay bricks kilns. This was done by applying one of the well known desulphurization techniques, prior to this, the rate of emission of sulphur dioxide in the flue gases was studied.

It was found that sulphur dioxide which is formed as a result of using feul oils containing sulphur, may be captured by the clay products at low temperatures. At high temperatures, sulphur dioxide is formed due to sulphur present in both the fuel oil and the clay product.

The desulphurization technique proposed is a wet-absorption process using a mixture of calcium hydroxide and sodium carbonate. Material and energy balancies, selection of equipment, capital and operating costs has been estimated.

INTRODUCTION

It has long been known that, sulphur dioxide is very harmful to human health, vegetation and to some building materials. Investigations concerning the toxicology of sulphur dioxide has proved that the percentage fatal in 30 minutes or less is 0.2% wt., while the maximum safe concentration is 0.01 PPM,(1). Moreover, sulphur dioxide becomes more dangerous if it is emitted with susbended matter and ashes(2). Since 1970, the U.S. Environmental Protection Agency has established the folowing National Primary and Secondary Ambient - Air Qualty Standards,(3):

	Averaging time	Primary Standards
SO_2	Annual arithmetic mean	80 µg/m³ (0.03 PPM)
	Max. 24 hr concentration*	365 µg/m³ (0.14 PPM)
		Secondary Standards
	3 hr concentration*	1300 µg/m³ (0.5 PPM)

* Not to be exceeded more than Once a year.

For the above reasons, desulphurization of stack gases of high sulphur fuel-fired clay brick kilns, power stations and other industrial processes, is a must to reduce the amount of sulphur dioxide emitted from the stacks with the flue gases and consequently reduce its concentration in the ambient atmosphere to the allowable limits. Prior to the use of the relatively new methods of flue gas desulphurization, other ways such as the use of fuels free of sulphur compounds or the use of high cheminys has been practiced. In other words, there are three ways to reduce the sulphur dioxide emission:

1. Use of high cheminys.
2. Use of sulphur free-fuels(5).
3. Use of flue gas desulphurization units(2.4.6-8).

The use of high cheminys may reduce the effect of sulphur dioxide in the near surroundings. But this is only true if the region where the cheminys are located is not a crowded one. Moreover, in days of

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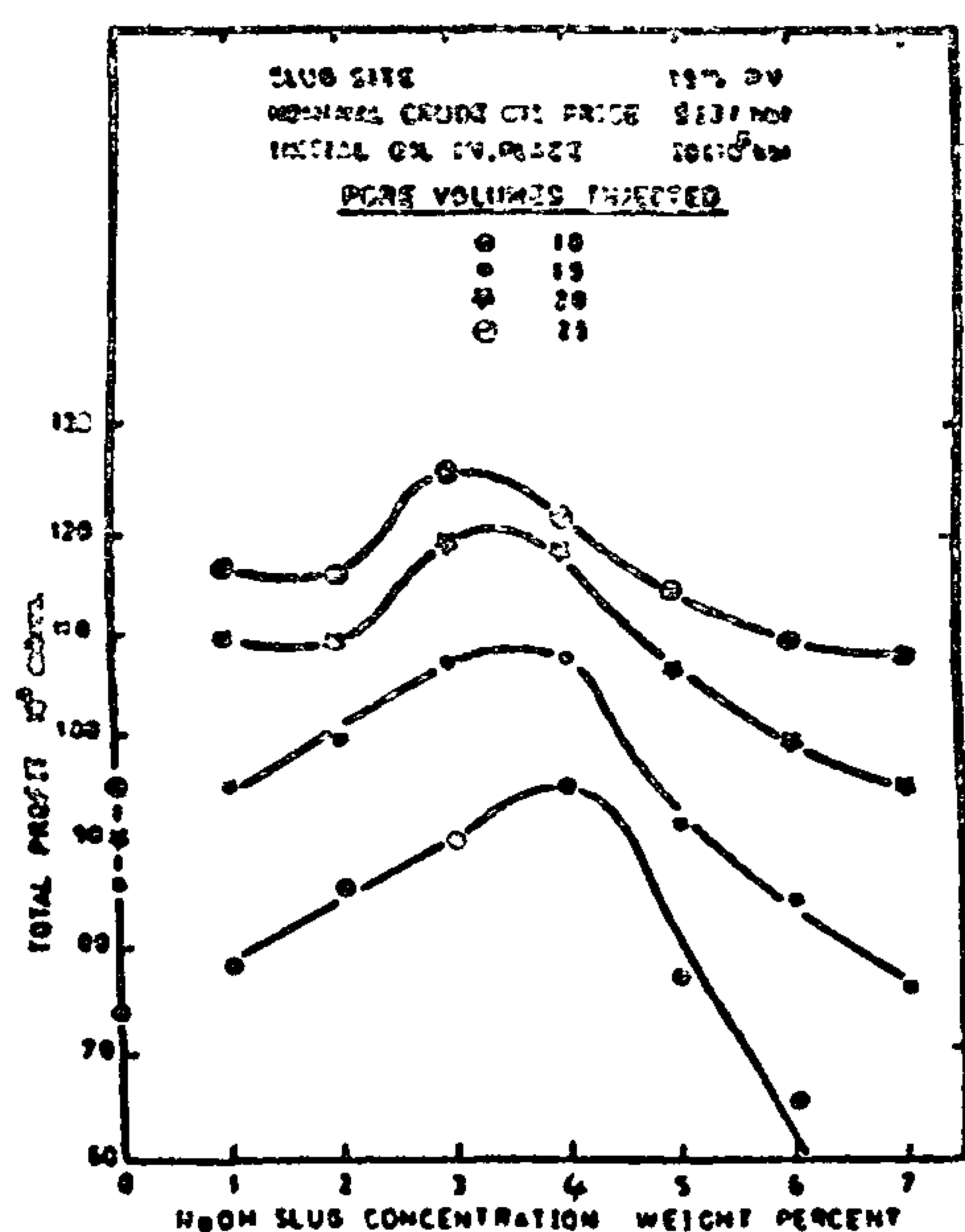


FIG. 3 :TOTAL PROFIT OF OIL RECOVERABLE BY ALKALINE WATERFLOOD AS FUNCTION OF ALKALINE SLUG CONCENTRATIONS AND PORE VOLUMES OF INJECTED DISPLACEMENT WATER

Conclusions:

Based on the experimental results of recovering South Geisum crude oil by alkaline solution flooding and on data obtained about South Geisum resrevoir, the economic evaluation approach showed that:-

1. At 1.0 and 1.5 PV of injected displacement water, the economically optimum NaOH slug concentration is the 4% by weight NaOH.

2. At 2.0 and 2.5 PV of injected displacement water, the optimum slug concentration is 3% by weight NaOH.

3. The maximum profit is achieved at 2.5 PV of injected displacement water using 3% NaOH slug concentration.

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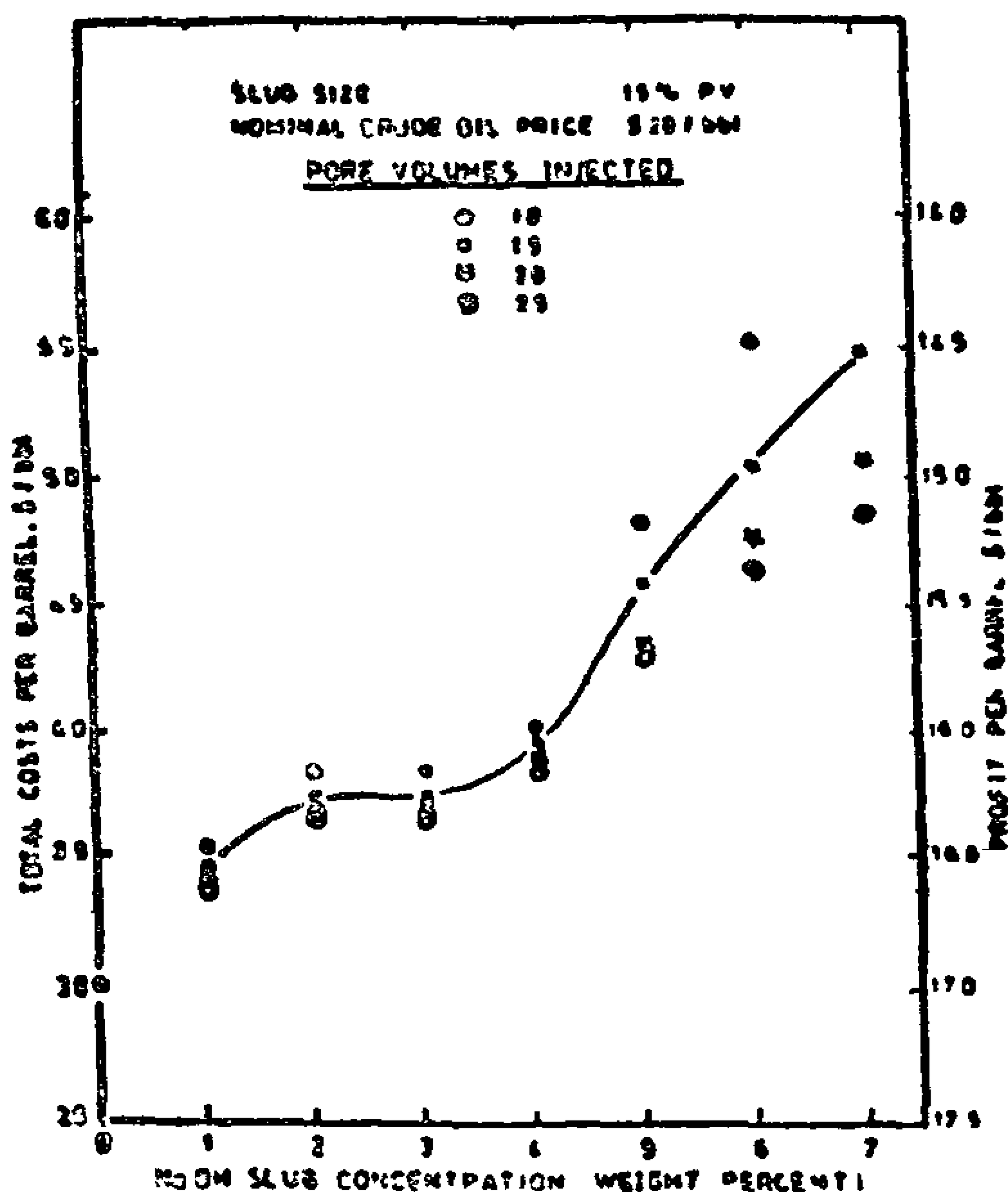


FIG.2 · TOTAL COSTS AND PROFIT PER BARREL OF OIL RECOVERED BY ALKALINE WATERFLOOD AS FUNCTIONS OF ALKALINE SLUG CONCENTRATIONS AND PORE VOLUMES OF INJECTED DISPLACEMENT WATER

Profit of Oil Recovered by Alkaline Waterflood:

The profit per barrel of the oil recovered by alkaline waterflood is dependent on both the nominal crude oil price and the total costs per barrel to be recovered. i.e.

$$p = \text{crude oil price} - Co \qquad (10)$$

where:

p: Profit per barrel, dollars. —

As the crude price was considered as $ 20 per barrel, equation (10) can be rewritten as:

$$p = 20 - [(7.8867\ C/RoXSoi) + 3.13)]$$

$$p = 16.87 - (7.886\ C/Ro\ Soi) \qquad (11)$$

The results of profit per barrel calcultions on the basis of equation (11) are shown in Fig. 2.

However these results could give false indications to the economically optimum conditions which provide the maximum profit unless the total recoverable oil is considered as well as the profit per barrel. Thus,

$$Pt = p\ (RO)\ X\ (IOIP)\ X\ 0.01\ \$ \qquad (12)$$

where:

Pt: Total profit of the alkaline waterflood project dollars, and

IOIP: Initial oil in-place, barrels.

An estimation of the intial oil in-place for South Geisum oil field is 20 MM bbls. Equation (12) can be rewritten as:

$$Pt = (16.87 - 7.8867\ C/Ro\ X\ Soi)\ (20\ X\ 10^{-6})\ X\ 0.01\ X\ Ro$$

$$Pt = [16.87\ X\ Ro - (7.8867\ C/\ Soi)]\ (0.2\ X\ 10^{-6}) \qquad (13)$$

Equation (13) is a suitable tool to determine the economically optimum concentration and pore volume of injected displacement water which provide the maximum profit. Results of the calculations based on equatation (13) are shown in table (5). Fig. 3 is a plot of the total profit in millions of dollars versus the alkaline slug concentration at different pore volumes of injected displacement water.

It is clear from fig. 3 that both the 3% and 4% by weight NaOH concentrations give the maximum profits depending on the PV injected. At 1.0 and 1.5 PV injected, the 4% NaOH concentration is the optimum concentration. The maximum profit is achieved at 3% NaOH slug concentration and 2.5 pore volumes of injected displacement water. This conclusion is consistent with the results of the experimental work.

Table 5: Total Profit Of Oil Recovered By Conventional and Alkaline Waterflood Process Of Different NaOH Slug Concentration at Different Pore Volumes Of Injected Displacement Water

NaOH SLUG CONC., WT%	TOTAL PROFIT AT DIFFERENT PORE VOLUMES OF INJECTED DISPLACEMENT WATER, $1.E6			
	1.0 PV	1.5 PV	2.0 PV	2.5 PV
0	74.12	86.70	90.10	95.20
1	78.79	94.65	109.49	117.25
2	85.67	99.17	108.95	116.71
3	90.27	107.14	118.95	126.04
4	95.22	107.37	116.14	121.54
5	77.14	91.31	106.15	114.25
6	65.18	84.08	98.97	109.72
7	40.00	76.10	94.66	107.48

CV = \$ 0.13/bbl (5)

c) **Fixed Operating Costs (Cf):**

These types of costs were assumed to be the same as that of the conventional waterflood. The conventional waterflood costs under the Egyptian reservoir conditions were estimated, according to I. Mahgoub (personal communication), as an average of \$ 3 per barrel, i.e.

Cf = \$ 3/bbl (6)

d) **Total Costs of Alkaline Waterflood:**

From equations 1,4,5 and 6

Co = [0.496 X (PV) X (C)/1000000 X Qor] + 3.13 (7)

and Qor can be substituted by:

$Qor = 0.06289 \times (Ro) \times (IOIP) \times 10^{-6}$

since IOIP = Soi X (PV)

$Qor = 0.06289 \times (Ro) \times (PV) \times Soi \times 10^{-6}$ (8)

where:

Ro: Oil Recovery by alkaline waterflood, % of IOIP.

IOIP: Initial oil in-place, cc.

Soi: Initial oil saturation, fraction and 0.000006289: Conversion factor from cc. to barrels.

Equation 7 can be rewritten as:

Co = [7.8867/Ro X Soi] + 3.13 \$/bbl (9)

Equation (9) determines the total cost of the oil recovered by alkaline waterflood as expressed in dollars per barrel. It is clear from this equation that the total costs are dependent on the slug concentration, oil recovery and initial oil saturation. As initial oil saturations for all floods are about the same, total costs vary with the slug concentration and the oil recovery which is affected by both slug concentration and pore volumes of injected displacement water.

Table (3) shows the oil recovery of conventional waterflood (0.% NaOH) and alkallne waterfloods of different slug concentrations at different pore voumes of injected displacement water as were obtained form the experimental work (see also Fig. 1). Table (4) shows the results of the calculations of total costs of oil recovered by alkaline waterflood based on equation (7). Fig. 2 is a plot of total costs of oil recovery in dollars per barrel versus NaOH slug concentration at different pore volumes of injected displacement water.

Table 3: Cumulative Oil Recovery By Conventional and Alkaline Waterflood Of Different Slug Concentration At Different Pore Volumes Of Injected Displacement Water

RUN NO.	NaOH SLUG CONCENTRATION WEIGHT %	INITIAL OIL SATURATION	CUMULATIVE OIL RECOVERY AT DIFFERENT PORE VOLUMES OF INJECTED DISPLACEMENT WATER, PERCENT OF IOIP 1.0 PV	1.5 PV	2.0 PV	2.5 PV
1	0	0.839	21.8	25.4	26.5	28.0
2	1	0.853	23.9	28.6	33.0	35.3
3	2	0.844	26.5	30.5	33.4	35.7
4	3	0.853	28.4	33.4	36.9	39.0
5	4	0.859	30.4	34.0	36.6	39.2
6	5	0.921	25.4	29.6	34.0	36.4
7	6	0.892	22.5	28.1	32.5	35.7
8	7	0.898	15.5	26.2	31.7	35.5

Table 4: Total Costs Per Barrel Of Oil Recovery By Conventional and Alkaline Waterflood Of Different Slug Concentration At Different Pore Volumes Of Injected Displacement Water

RUN NO.	NaOH SLUG CONCENTRATION WEIGHT %	CUMLATIVE OIL RECOVERY AT DIFFERENT PORE VOLUMES OF INJECTED DISPLACEMENT WATER, \$/BBL 1.0 PV	1.5 PV	2.0 PV	2.5 PV
1	0	3.00	3.00	3.00	3.00
2	1	3.52	3.45	3.41	3.39
3	2	3.84	3.74	3.69	3.65
4	3	4.11	3.96	3.88	3.84
5	4	4.34	4.21	4.13	4.09
6	5	4.82	4.58	4.34	4.31
7	6	5.51	5.04	4.79	4.63
8	7	7.10	5.48	5.07	4.86

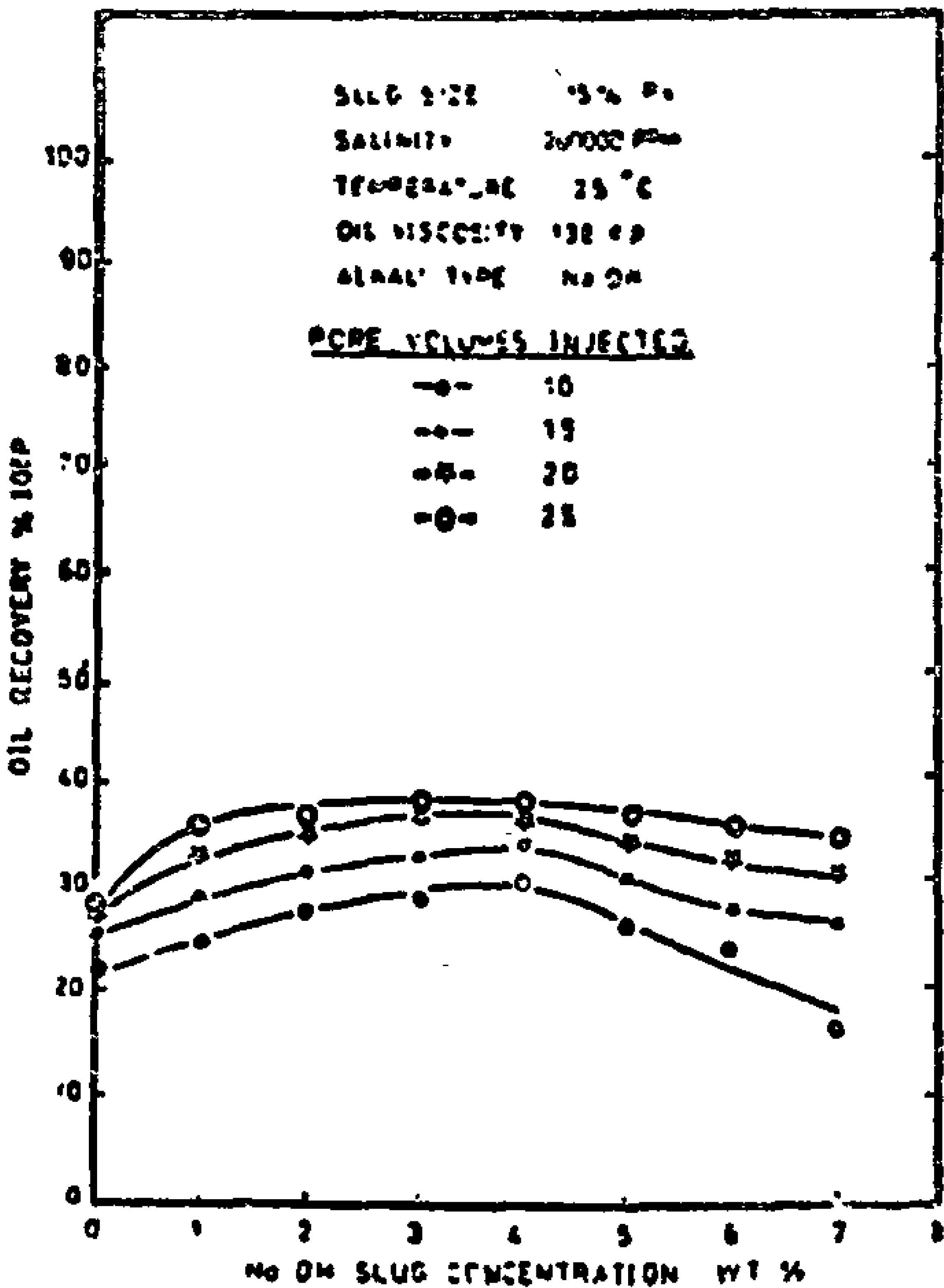


FIG. EFFECT OF SLUG CONCENTRATION ON OIL RECOVERY AT DIFFERENT PORE VOLUMES OF INJECTED DISPLACEMENT WATER

1 — Economically optimum slug size is 15% PV (1).

2 — Oil price is US $ 20 per barrel.

3 — Rate of return is not considered.

4 — Cost of equipment to mix and inject alkaline slug is not considered.

5 — Costs of converting producing wells to injection wells and fixed operating expenses are assumed to be the same as that of conventional waterflood.

6 — Cost are based on the 1983's prices

Calculation of Alkaline Waterflooding Costs:

These costs are that of the oil recovered by using NaOH waterflood. To estimate these costs, both the costs of chemical (NaOH) agent and the operating sosts, were considered.

Thus

$$CO = Ca/Qor + Cv + CF \qquad (1)$$

where:

Co = total cost of oil recovered by alkaline waterflood, dollars per barrel,

Ca = Costs of alkaline agent, dollars,

Qor = Volume of oil recovered by alkaline waterflood, barrels,

Cv = Variable operating costs, dollars per barrel, and

Cf = Fixed operating costs, dollars per barrel.

a) **Alkaline Agent Costs: (Ca)**

Table 1 shows the estimated alkaline chemical costs for different nominal crude oil price cases. At a nominal crude oil price of $ 20/bbl, alkaline chemical costs are $ 0.15/active pound, i.e.

$$Ca = 0.15 \ (w) \qquad (2)$$

where:

w: Active weight of alkaline chemical, pounds

Table 1: Price Estimates For Chemicals Used in Chemical Flooding at Various Nominal Oil Prices (49).

CHEMICAL	CHEMICAL COST ($/ACTIVE POUND)			
	$20/BBL	$30/BBL	$40/BBL	$50/BBL
Primary Surfactants	0.27	0.32	0.37	0.42
Secondary Surfactants	0.37	0.44	0.51	0.58
Polymers	1.42	1.60	1.78	1.96
Alkaline Agents	0.15	0.17	0.19	0.21

and w = slug size X alkalne concentration

$$= 0.15 \times (PV) \times (C) \times 2.2046 \times 10^{-5}$$

$$w = 3.306 \times (PV) \times (C) \times 10^{-6} \quad (3)$$

where:

PV: Pore volume, cc.

C: Alkaline concentration, weight percent and 2.2046×10^{-3} : conversion factor from gms to pounds.

Thus, equation (2) can be rewritten as:

$$Ca = 0.496 \times (PV) \times (C) \times 10^{-6} \quad (4)$$

b) **Variable Operating Costs (CV):**

Table 2 shows the estimated operating costs for chemical flooding processes [3]. For the tested alkaline waterflood case, variable operating costs are $ 0.13/bbl, i.e.

Table 2: Variable Operating Expenses For Chemical Flooding (Dollars/bbl)

	Surfactant	Polymer	Alkaline
Chemical Slug Injection	0.2	--	0.10 (0.2 ad·) *
Polymer Solution Injection	0.1	0.10	0.10
Produced Water Disposal	0.03	0.03	0.03 *
Produced Oil Treatment	0.50	0.05	0.50

*Advanced case only.

ECONOMICAL EVALUATION OF SOUTH GEISUM CRUDE OIL DISPLACEMENT BY ALKALINE SOLUTIONS

M.H. Sayyouh*, A.A. Abdel Waly*, A.Z. Awara** and A.O. Salama*

ABSTRACT

An economical approach to evaluate the oil recovered from South Geisum field by alkaline solution flooding based on experimental results showed that at 1.0 and 1.5 pore volume (PV) of injected displacement water, the economically optimum sodium hydroxide slug concentration is the 4% by weight sodium hydroxide, while at 2.0 and 2.5 pore volumes of injected displacement water, the economically optimum one is the 3% by weight sodium hydroxide. The maximum profit is achieved at 2.5 PV of injected displacement water using a 3% by weight sodium hydroxide slug concentration.

The study was carried out assuming that the economically optimum slug size is 15% (PV) (1). The costs are based on the 1983 prices where the average oil price was about US $ 20 per barrel.

Intorduction:

In a fluid injection operation the amount of economic recovery is controlled by a combination of factors which are quantitatively different from one reservoir to another. Some factors are nature derived, others are controlable. Some of these factors are displacement efficiency, sweep efficiency, and economy.

Economic factors can overshadow the physical ones in commercial oil production. Even if provisions are made to improve recovery by increasing displacement and sweep efficiencies, cost to accomplish this cannot be higher than added oil value. Considerable variables for any economic evaluation include estimated amount of oil recoverable, cost to conduct the operation and price of the oil. The higher the crude price, the more feasible to recover oil from leaner deposits using effective but costly methods[2].

Alkaline waterflood is not an exception. Therefore this part of the study is an effort to apply economic considerations on the alkaline waterflood with the aim of roughly estimating the costs of recoverable oil by NaOH solutions of different concentrations and constant slug size of 15% PV at different pore volumes of injected displacement water.

Typical Types of Cost Required for an Alkaline Waterflood Project:

a) **Startup Cost:**

This cost includes both (i) the cost of equipments to mix and inject alkaline slug and to soften water and (ii) the cost of converting some of the producing wells to injection wells.

b) **Operating Cost:**

These costs include two categories:

(i) Fixed operating costs which are assumed to be the same as the operating expenses for waterflood, and

(ii) Variable operating costs which are mainly for preparation and injection of chemical slugs, water disposal and produced oil treatment.

In order to simplify the problem, some assumptions were considered through this economic study:

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** Geisum oil Comp.

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INST. OF CHEMICAL ENGINEERS

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$\bar{P}$: Average power, W.
P_r : Rated power, W.
v : Wind speed, ms^{-1}.
$\bar{V}_{10}$: Average wind speed at 10-m height, ms^{-1}.
$\bar{V}_z$: Average wind speed at z-m height, ms^{-1}.
V_i : Cut-in wind speed, ms^{-1}.
V_r : Rated wind speed, ms^{-1}.
V_o : Cut-off wind speed, ms^{-1}.
x : Tip-speed ratio.
z : Anemometer height, m.
α : Exponent for height projection.
ρ : Air density, kg m^{-3}.

APPENDIX

Weibull -1 Parameters at Z and 10-m level

Site*	Z,m	K_z	C_z	$\bar{V}_z$	K_{10}	C_{10}	$\bar{V}_{10}$
1. El-Sallum	14	1.73	4.648	4.14	1.679	4.285	3.816
2. Sidi-Barrani	13	1.89	5 861	5.20	1.85	5.53	4.91
3. Mersa Matruh	15	1.48	6.49	5.85	1.43	5.95	5.38
4. El-Dabaa	13	1.71	5.957	5.30	1.67	5.63	5.01
5. El-Dekhila	16	1.91	5.500	4.88	1.83	4.94	4.38
6. Ras El-Tin	24	1.68	4.799	4.28	1.55	3.72	3.43
7. Alexandria	18	1.59	4.846	4.34	1.51	4.20	3.76
8. Baltim	10	1.06	3.290	3.21	1.06	3.29	3.21
9. Port Said	19	1.97	5.550	4.92	1.86	4.78	4.29
10.W.El-Natrun	10	1.26	4.671	4.34	1.26	4.671	4.34
11.Coiro W.	12	1.83	5.092	4.52	1.80	4.88	4.3
12.Abu Sware	14	1.46	4.352	3.94	1.42	4.0	3.6
13.Belbaise	18	1.68	3.910	3.49	1.59	3.35	2.99
14.Enshas	6	1.03	2.755	2.72	1.08	3.16	3.12
15.Kattamia	10	1.19	3.993	3.76	1.19	3.99	3.76
16.Cairo	18	1.29	4,116	3.80	1.22	3.54	3.26
17.Almaza	25	1.92	4.615	4.09	1.77	3.65	3.23
18.Helwan	20	1.45	4.523	4.09	1.36	3.8	3.43
19.Beni Swafe	18	1.08	4.817	4.67	1.02	4.17	4.05
20.Elmenia	20	1.60	3.538	3.17	1.5	2.92	2.62
21.Asiut	17	1.75	4.310	3.83	1.67	3.77	3.35
22.Aswan	20	1.96	5.389	4.77	1.84	4.58	4.05
23.ElKharga	14	1.94	4.366	3.87	1.88	4.02	3.56
24.Suiz	16	1.53	4.246	3.82	1.47	3.77	3.39
25.Hurghada	12	2.17	6.960	6.24	2.14	6.70	5.93
26.Kussaire	15	2.02	5.114	4.53	1.95	4.65	4.12
27.Ras Benas	10	1.13	4.982	4.76	1.13	4.98	4.76
28.Abu Redis	16	1.51	4.943	4.46	1.45	4.45	3.99
29.El-Tor	14	2.28	6.794	6.02	2.21	6.34	5.61

* Data of Ref.(2)

Also, the power $\bar{P}''$ is some how related to $\bar{V}/V_r$ when V_o/V_r is constant as it could be seen from the tabulated results. Practical values of Vi/Vr are kept within 0.4-0.5, (15), hence variation of $\bar{P}'/P_r$ is small. On the contrary, variations of V_o/V_r will have direct effect on $\bar{P}''/P_r$, because V_o/V_r may range from 1 up to 2.5 in certain cases. It could be concluded that $\bar{P}/P_r$ is increasing as $\bar{V}/V_r$ increases, because sites with lower average wind speeds like El-Arish has low average power output, and a site like Ras Ghareb has higher $\bar{V}/V_r$ with higher average power. Certainly wind machines with cut-off rato V_o/V_r lower than tabulated will lead to significant decrease in $\bar{P}/P_r$ because of the direct effect on $\bar{P}''/P_r$ which dominates the effect of $\bar{P}'/P_r$.

The choice of the ratio Vi/Vr is then not as critical to the power calculation as Vo/Vr. The predicted output power does not include the efficiency of generator or any gear train in the wind turbine system. Transformers and inverters are also not considered.

CONCLUSION

Two methods were used to fit the frequency distributions of wind speeds to the two parameter Weibull distribution for different sites in Egypt Most of the sites were found to have the best fit when using the metod of linear regression rather than using the percentile method. The two Weibull parameters for the best fitted distribution are then projected to the 10-m level. Subsequently, the average output power of a hypothetical wind turbine using the corrected Weibull parameters was predicted by two methods; the quadratic and the exponential relationships. The differences in estimation using both methods are within 7% which is considered acceptable. The model as presented here, is valid to estimate and compare wind at other different sites and wind turbine characteristics as well.

NOMENCLATURE

The symboles listed below are those frequently used. Other symboles and abbreviations which are not extensively used are explained throughout the text.

A_r : Rotor area, m^2.

C_p : Power coefficient.

C : Weibull scale parameter, ms^{-1}.

C_{10}: Weibull scale parameter at 10.m height, ms^{-1}.

C_z : Weibull scale parameter at z-m height, ms^{-1}.

C_f : Capacity factor, $\bar{P}/P_r$.

D : Statistical maximum deviation.

K : Weibull shape parameter.

K_{10}: Weibull shape parameter at 10-m height.

K_z : Weibull shape parameter at z-m height.

P : Power, W.

Table 3: Average power of selected sites

Site	Weibull parameters		Quadratic			Exponential		
	C_{10}	K_{10}	$\bar{P}'_1/P_r$	$\bar{P}''_1/P_r$	Cf_1	$\bar{P}'_2/P_r$	$\bar{P}''_2/P_r$	Cf_2
1. El-Arish	3.78	1.53	0.1114	0.1322	0.2436	0.1732	0.1322	0.3054
2. Borg El-Arab	6.91	2.08	0.1208	0.4678	0.5886	0,1846	0.4678	0.6525
3. Hurghada (1)	6.95	2.37	0.1271	0.4916	0.6187	0.1892	0.4916	0.6808
4. Hurghada (2)	6.70	2.14	0.1262	0.4505	0.5767	0.1919	0.4505	0.6424
5. Mersa Matruh	5.95	1.43	0.1029	0.3399	0.4428	0.1694	0.3399	0.5093
6. Ras Ghareb	9.53	3.29	0.100	0.7918	0.8918	0.0889	0.7918	0.8807

The quadratic and exponential estimations are tabulated as

$$C_{f1}=\bar{P}'_1/P_r + \bar{P}''_1/P_r,$$

$$C_{f2} = \bar{P}'_2/P_r + \bar{P}''_2/P_r$$

The difference between C_{f1} and C_{f2} lies in the estimation of $\bar{P}'/P_r$, because $\bar{P}''/P_r$ for both methods is independent on the method of calculations as seen from Eqn. 14. The differences approaches 7% of the estimated average power which is considered acceptable for practical applications. It is evident from Eqn. 14 that the values of $\bar{P}'_1$ and $\bar{P}'_2$ for different sites are dependent on the cut-in and rated wind speed V_i and V_r, and those of $\bar{P}''_1$ and $\bar{P}''_2$ are limited by rated and cut-off wind speeds V_r and V_o. Although different sites have different mean wind speeds, it seems that the partial power $\bar{P}'$ is not much affected by the average wind speeds rather than the wind speed distribution parameters as shown in Tab. 3, because the machine characteristic Vi is kept constant as in Tab. 4.

Table 4: Dependence of average poweron different parameters.

Site	V_i/V_r	V_o/V_r	V/V_r	C_{f1}	C_{f2}
1. El-Arish	0.417	2.5	.562	0.2436	0.3054
2. Borg El-Arab	0.417	2.5	1.02	0.5886	0.6525
3. Hurghada(1)	0.417	2.5	1.027	0.6187	0.6808
4. Hurghada(2)	0.417	2.5	0.988	0.5767	0.6424
5. Mersa Matruh	0.417	2.5	0.897	0.4428	0.5093
6. Ras Ghareb	0.417	2.5	1.423	0.8918	0.8807

are used to demonstrate the procedure suggested in this work.

The first method is represented by :

$$P_1(v) = A + B v + C v^2 \qquad (9)$$

where A, B and C are constants which could be estimated using Eqs. 8 and by defining Vm as

$$V_m = \frac{V_i + V_r}{2},$$

and $$P_m = P_r \left(\frac{V_m}{V_r}\right)^3$$

then the constants are given by:

$$\left.\begin{aligned} A &= P_r V_i \, [V_m - 2V_r (V_m/V_r)^3] \, / 2(V_r - V_m)^2 \\ B &= P_r \, [V_r - 3V_m + 4V_m (V_m/V_r)^3] / 2(V_r - V_m)^2 \\ C &= P_r \, [1 - 2(V_m/V_r)^3] \, / 2(V_r - V_m)^2 \end{aligned}\right\} \qquad (10)$$

The second method is described as:

$$P_2(v) = a + b v^k \qquad (11)$$

where k is the Weibull shape parameter. The constants a and b could be found from the relation:

$$\left.\begin{aligned} a &= P_r V_i^k \, / (V_i^k - V_r^k) \\ b &= P_r \, / \, V_r^k - V_i^k \end{aligned}\right\} \qquad (12)$$

Defining a cpacity factor Cf such as:

$$C_f = \frac{\bar{P}}{P_r} \qquad (13)$$

where $\bar{P}$ is the average power given by the formula

$$\bar{P} = \int_{V_i}^{V_r} P(v) f(v) dv + \int_{V_r}^{V_o} P_r f(v) dv \qquad (14)$$

Equations 13 and 14 are analyzed using the expressions for P1 (v) and P2(v). From Eqs. 9-12, and wind speed distributon f(v) from Eq. 1. with best fitted and corrected Weibull parameters c10 and k10 from Tab. 2. Then the capacity factor Cf is calculated for the chosen sites. The output of these calculations is given in Tab. 3., where the instantaneous power output for a typical site in Ras Ghareb is llustrated in Fig. 5 for both P1 (v) and P2 (v).

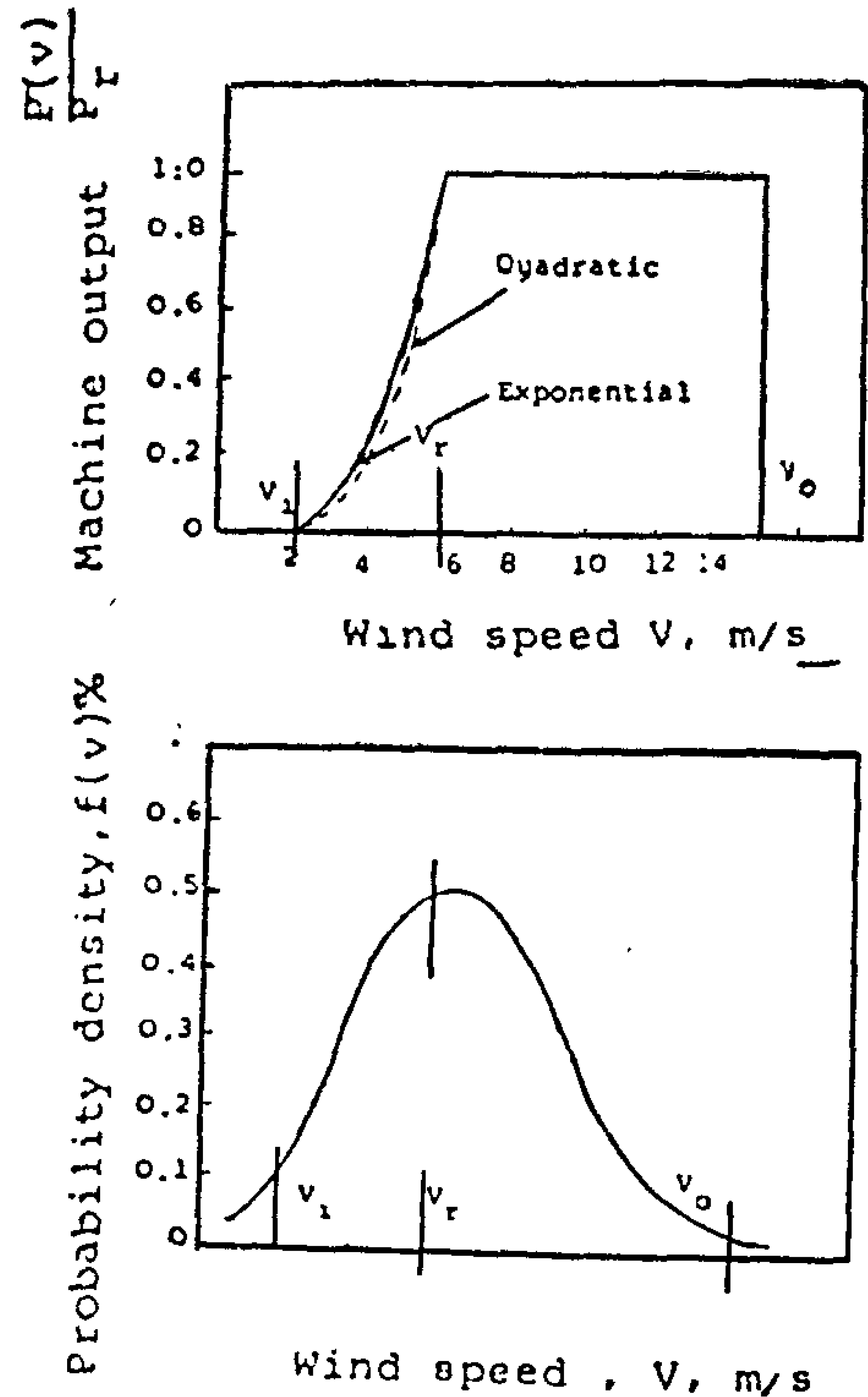


Fig. 5: Illustration of machine output power and probability density function versus wind speed for Ras Ghareb

To evaluate the integrals in Eqn. 14, using either the expression for P1 (v) or P2 (v), the trapezoidal numerical method is used using 7 intervals over each specified range of integration.

The percentage of power generated for $V_i < v < V_2$ is given as $\bar{P}'$, and the percentage of power generated for $V_r < v < V_o$ is given as $\bar{P}''$. Although the cut-in, rated and cut-out wind speeds Vi, Vr and Vo differes from machine to machine, the sample calculations are calculated for Vi = 2.5, Vr = 6 and Vo=15 m/s which is considered acceptable for small size machines. For values different from those, the limits of integration could be changed to cover the required ranges.

where Kz is the weibull shape parameter at observed height of Z meters.

The output of (5), (6), and (7) for c and k values is tabulated in Tab. 2 for the selected sites mentioned in Tab. 1. The Weibull-1 parameters are found to have the best fit when compared with Weibull-2 parameters. The best fitted weibull values are then corrected to the 10-m level as shown in the table. Other c10 and k10 parameters for different promising sites are shown in appendix. 1.

Table 2 : Corrected Weibull parameters

1.El-Ariesh	Weibull-1	1.75	.43	.336				
	Weibull-2	4.33	1.58	.139	*	3.78	1.53	3.37
2. Borg El-Arab	Weibull-1	6.24	1.99	.28	*	6.91	2.08	6.12
	Weibull-2	7.99	1.07	.32				
3.Hurghada-1	Weibull-1	6.95	2.37	.272	*	6.95	2.37	6.16
	Weibull-2	11.50	.86	.295				
4. Hurghada	Weibull-1	6.96	2.17	.282	*	6.70	2.14	5.93
	Weibull-2	11.5	.86	.295				
5.Mersa-Matruh	Weibull-1	6.49	1.48	.248	*	5.95	1.43	5.38
	Weibull-2	7.42	1.04	.271				
6.Ras-Ghareh	Weibull-1	9.53	3.29	.298	*	9.53	3.29	8.54
	Weibull-2	17.17	.658	.377				

OUTPUT POWER CALCULATIONS:

In general, the output power of a wind machine is given by the formula :

$$P(v) = \tfrac{1}{2}\rho A_r C_p v^3$$

where p is the air density, Ar is the rotor area subjected to wind, Cp is the power coefficient of the machine and v is the wind speed at the site. The wind speed is described by the Weibull distribution as stated above. The power coefficient Cp is a design parameter and is a function of wind turbine rotor characteristic and the working tip - speed ratio of the turbine. For different designs, a generalized form of the Cp-X curves are given in Fig. 4. In most cases, the Cp of the machine is not constant during operation. Therefore a complete knowledge of Cp-X relation is necessary to estimate the output power, otherwise approximate solutions have to be used.

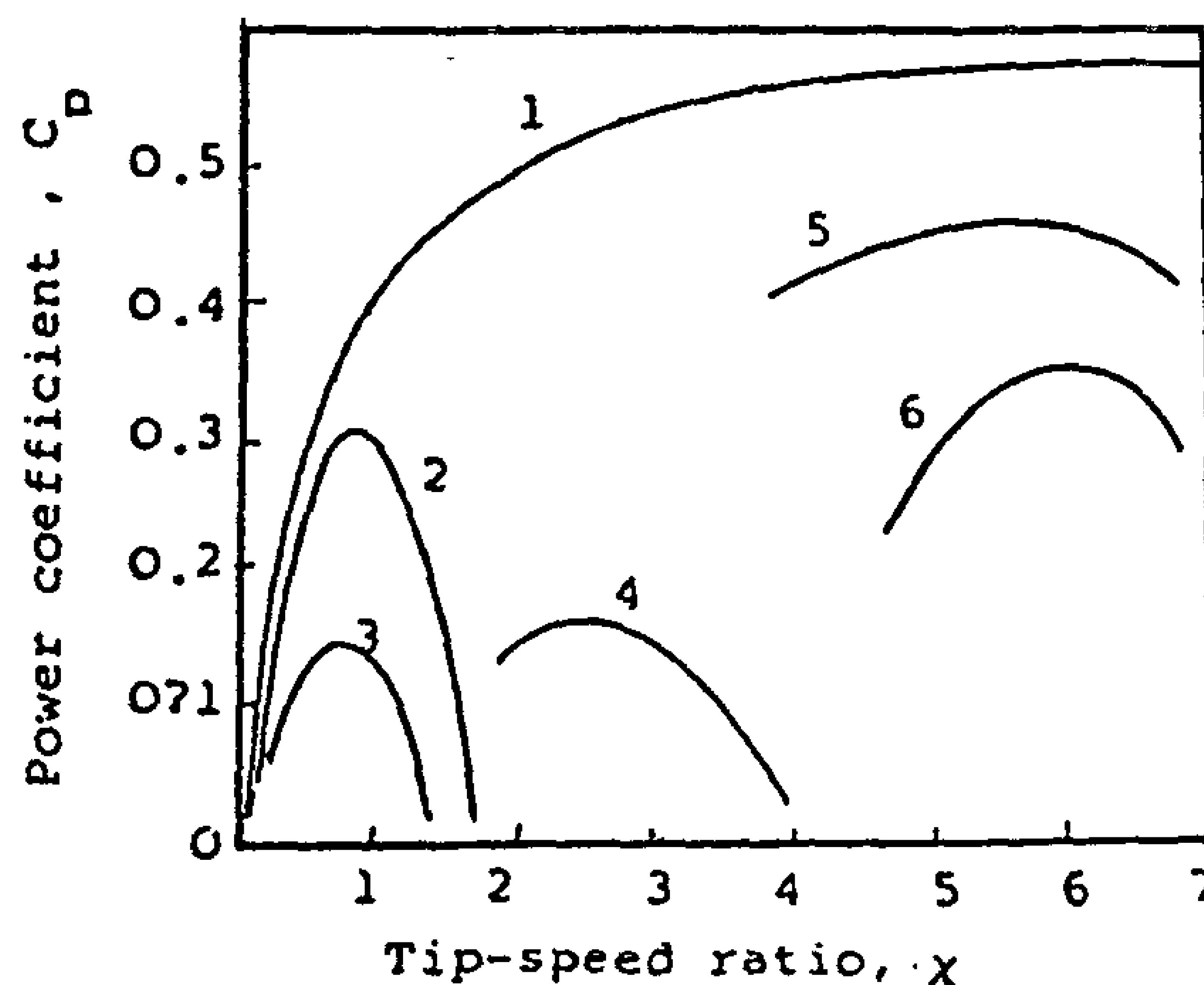


Fig. 4: Typical performance of wind power machines

1. Ideal, 2. Multi-bladed, 3. Savonius,
4. Four blades, 5. High speed 2 blades
6. Darrieus type.

The output power P of a wind machine is not continuously generated over the whole range of wind speeds v. Let Vi, Vr, and Vo be the cut-in, rated, cut-off wind speeds respectively, then the power output P of a wind machine is given by :

$$\left.\begin{array}{ll} P=0 & , v < V_i \\ P=P(C_p, v) & V_i < v < V_r \\ P=P_r & V_r < v < V_o \\ P=0 & v > V_o \end{array}\right\} \quad (8)$$

where Pr is the rated power.

The power output in the partial power range, Vi $\angle$ V $\angle$ Vr, in case when manufacturer data is not avaiable may be estimated using different approximation methods. For example, a linear version for the partial power range is used in (10,11) and various degrees of polynomials are used in (7,12,13). In (12,14) recommendations are reported to apply a second degree polynomial expression and a correction using the wind speed standard deviation. Although many of such expressions can be used, a quadratic and an exponential, denoted by P1(v) and P2(v) respectively,

The kolmogrov/smirnov test is then used to find which of the two methods Weibull -1 or Weibull-2 fits the given data best. This test, (9) depends on the evaluation of the statistic D,where D is the maximum deviation between the cummulative distribution functions of the sampled data and the fitted distribution.

DATA CORRECTION FOR HEIGHT VARIATION:

After finding the best Weibull parameters c and k for each set of wind speed data, and as a fact that the anemometers are installed at different heights, as shown in Tab. 1, the parameters c and k should be projected to the same height for reasons of comparison. The 10-m level stated by the world Meteorological Organization, WMO, is accepted as a reference height. since some of the anemometers are located above buildings, it is important to check the effect of the building on the quality of the data before proceeding with height corrections. Figure 3. shows the wake produced by a building exposed to air flow and the variable distribution of air velocity ahead of the building. In general, to avoid most of the adverse effects of building wakes, the anemometer should be freely exposed outside the wake described in the figure and located at least twice the building height above the ground,(5) When applying this condition to the sites listed in tab. 1. it could be noticed that the anemometers are located outside the turbulent zone of the wake except the site No. 2 in table 1 where no exact data about the anemometer erection is available. Two separate cases of vertical wind projection can be used, the first one is wind speed projection of instantaneous wind speeds, e.g. one minute average, where a logarithmic profile law can be used.The second method is height internalation of long term average wind speeds, e.g. monthly or yearly averages. A power law relation governs this condition which will be dealt with in the present paper.

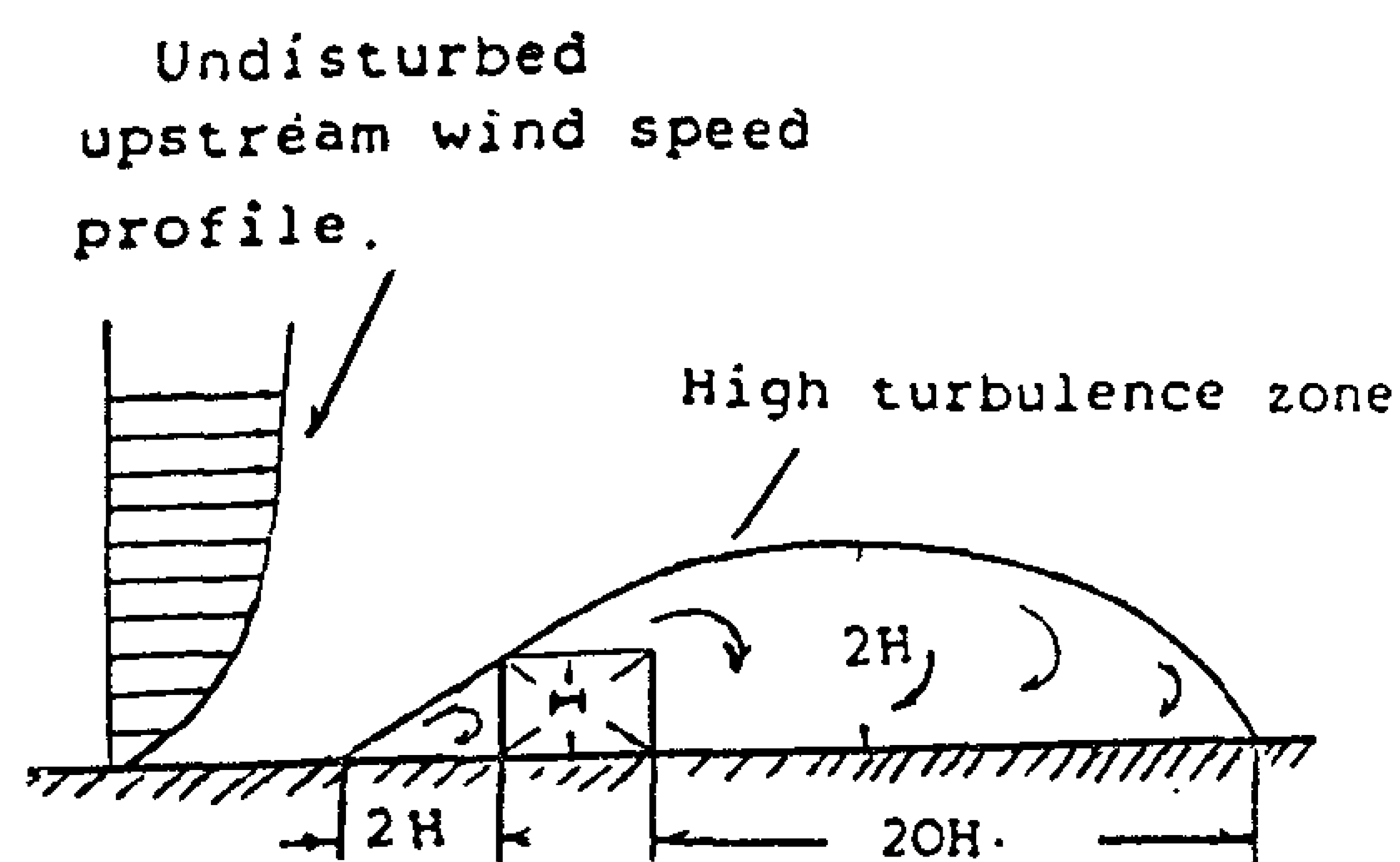


Fig. 3 : Region of highly turbulent flow due to building wake.

The 10-m level average wind speed will be given by the relation:

$$\frac{\bar{V}_{10}}{\bar{V}_z} = \left(\frac{10}{z}\right)^{\alpha}$$

where V10 is the average wind speed at height 10m above the ground, Vz the average wind, speed at height Zm, and a is an exponent which is not constant for all sites and vary also according to the atmospheric stability at the site. Moreover the value of the exponent depends on the surface roughness and the mean wind speed at the site. Higher values of a are expected for sites with higher stability conditions, low average wind speeds and sites with higher surface roughness.

A general form proposed to calculate the power exponent a at 10 m level for moderate average atmospheric stability and flat terrain with surface roughness Zo ranging between 0.05 and 0.5 m is given by

$$\alpha = \frac{(0.37-0.088\ \ln C_z)}{(1-0.088\ \ln \frac{z}{10})} \qquad (6)$$

where Cz is the Weibull scale parameter for a wind speed distribution measured at a height Z m. The Weibull shape and scale parameters at 10 m level k 10 and c10 could be calculated from :

$$\left.\begin{aligned} K_{10} &= K_z\left(1-0.088\ \ln \frac{z}{10}\right) \\ C_{10} &= C_z\left(\frac{10}{z}\right)^{\alpha} \end{aligned}\right\} \quad (7)$$

sured data is availble for the second quarter of 1985 and some of this data will be discussed in this paper.

SITES TO BE ANALYZED :

It is quite known from previous studies (6,7) that coastal areas in Egypt are promising sites to harness wind energy. Some locations on the Red sea coast shows higher annual wind speeds than those on the Mediterranean Sea Coast. Recent measurements indicated that average wind speed for Ras Ghareb reached up to 8.89 m/s at 10m level for the monthes April to July 1985. This figure is the highst recorded in Egypt till the present time which forecasts a very good potential windy site. On the account of this fact some selected sites on coastal areas are chosen as an example application for average power calculations. These sites are tabulated in Tab. 1 which includes the source of the data, the period during which the measurements were recorded, and the anemometer height.

Table 1. Specifications of selected sites

Site	period of Measur-ment.	Anemometer height		data source	$\bar{v}$*
		Above building	Above ground		
1.El-Arish	1959-67	10	15(1)	EMA	2.36
2.Borg El-Arab	1978	+	6(2)	EEA	4.91
3.Hurghada-1	Ap,July 85	-	10(3)	EEA	6.23
4.Hurghada-2	1957-75	8	12(1)	EMA	6.30
5.Marsa Matruh	1947-75	8	15(1)	EMA	5.23
6.Ras Ghareb	Ap.Jul 1985	-	10(3)	EEA	8.89

(1) Reference (2).

(2) Reference (3).

(3) Reference (4).

+ Not available.

* As given by the refernce, m/s.

STATISTICAL ANALYSIS OF WIND DISTRIBUTIONS:

There are several methods to hypothesize a wind speed distribution that represents the wind data at a given site. Among such distributions used are the univariate normal distribution, the Gamma distribution, the Rayligh distribution, and the Weibull distribution (8). The Weibull is by far the most commonly used distribution due to the relative simplicity of its cummulative probability distribution function F(v), and its readiness to derive closed form results for wind applications. The Weibull density function f (v) and distribution function F(v) are given by:

$$f(v) = \frac{k}{c}\left(\frac{v}{c}\right)^{k-1} e\left[-\left(\frac{v}{c}\right)^{k}\right] \quad (1)$$

$$F(v) = 1 - e\left[-\left(\frac{v}{c}\right)^{k}\right] \quad (2)$$

where c and k are the scale and shape parameters respectively.

To estimate the Weibull parameters c and k, two different methods are used and reported in the present paper, linear regression and the method of percentiles. In linear regression, double logarithms are taken for F(v) and equation of the form:

$$y = mx + \ell \quad (3)$$

is used, where:

$$y = \ell n\,[-\ell n\,(1 - F(v))]$$

$$x = \ell n\, v$$

the constants m & are estimated using least square method, and then used to obtain c and k as:

$$\left.\begin{array}{l} c = e\left[-\frac{\ell}{m}\right] \\ k = m \end{array}\right\} \quad (4)$$

The percentile method uses the median v 0.5, the 25% percentile, v 0.25, and the 75% percentile v 0.75 of the wind speed distribution to calculate c and k as:

$$\left.\begin{array}{l} k = 1.573\, \ell n\left(\frac{v_{0.75}}{v_{0.25}}\right) \\ c = v_{0.5} / (\ell n\ 2)^{1/k} \end{array}\right\} \quad (5)$$

value obtained for c and k using the first method are denoted Weibull-1 parameters, and those obtained using the second method are denoted Weibull-2 parameters

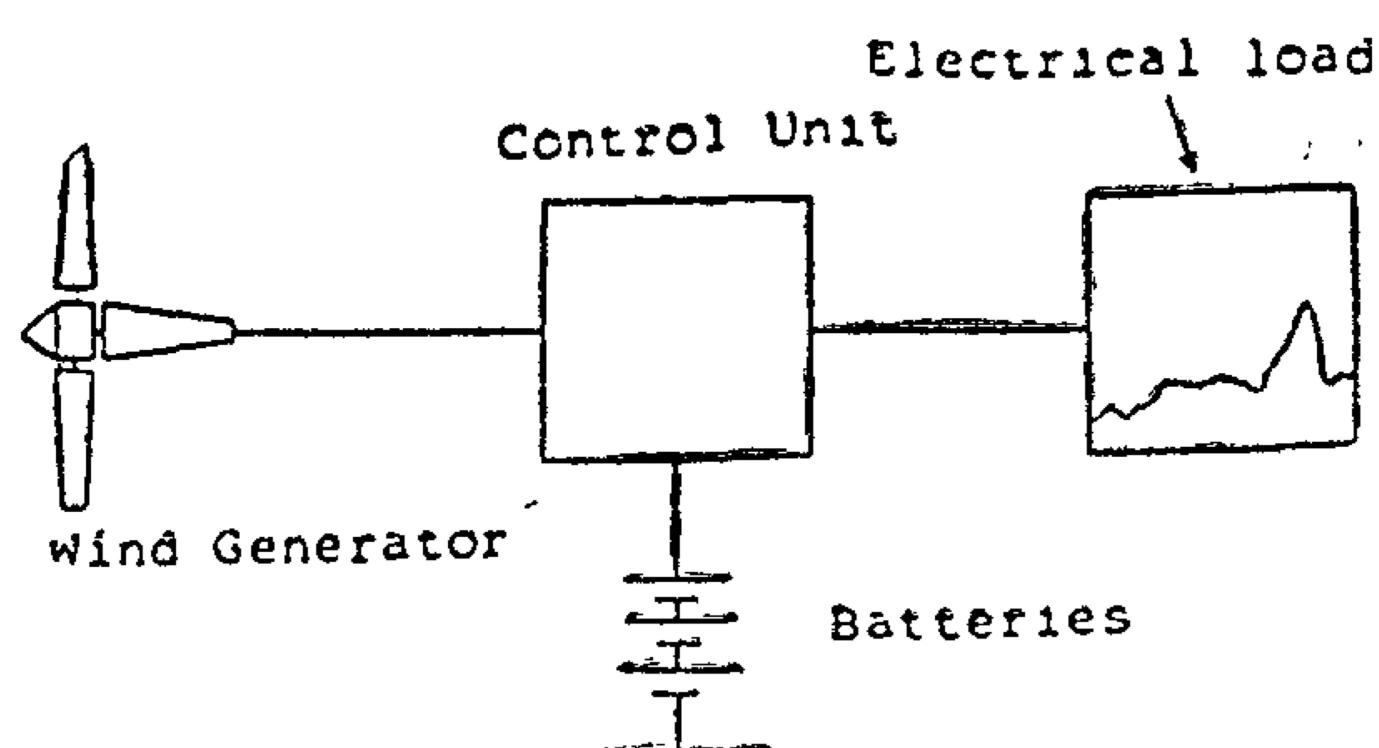


Fig. 2: Wind turbine generator for isolated user

nal wind characteristics should be specified in this case to match the availability and demand of energy.

The first mode of application is discussed in the Present paper where the average output power of a wind machine is estimated. The prediction of the output power of a wind machine is not only determined by knowing the machine characteristics but also the wind conditions at the chosen site. For this analysis, the detailed output of the candidate wind machine is needed as well as the accurate representation of the wind speed at the hub height level of the machine rotor. When the machine data is insufficient, approximate solutions may be used. The different methods and formulae for average power calculations will be discussed and example calculations is presented for some selected sites on the coastal areas of the Mediterranean Sea, Red Sea and the Gulf of Suez. The wind data used in the analysis was collected from different sources.

WIND SPEED CHARACTERISTICS:

The accuracy of power estimates is determined by the quality of the available wind data. Long term measurements with higher accuracy instrumentation are factors that increase the level of confidence. Moreover, the method of representing and analyzing the available data is of great importance. As an example, the number of wind speed classes to which the data is classified and the method of power estimates affect the accuracy of results obtained.

Previous studies (1) showed that different methods of analysis lead to different results. Differences between 3.2 - 10.5% occur when calculating power using the midpoint wind speed of each of an 11-class wind speed frequency distribution rather than using the individual hourly wind speeds. Other estimations showed 10-30% differences in calculating the wind power when using frequency distributions with only 3 or 6 wind speed classes. A third method which was based on fitting the frequency distribution to certain functions by accumulating the wind speed classes and the wind power was evaluated every decile gave less than 5% errors.

The wind data was made available by the Egyptian Meteorological Authority (EMA), (2) and the Egyptian Electricity Authority (EEA), (3,4). The data from EMA is mostly long term hourly averages summarized in surface wind data tables. The tables include monthly and yearly wind speed averages, and wind speed frequency distribution (using 8 wind speed classes) for each station. The period over which the data is averaged is different for the 69 stations covered by EMA along the coastal areas, Nile valley, and the western desert. Normally, this period is 30 years whenever available, otherwise it is stated in each table the years over which the data is summarized. This fact should be kept in consideration with respect to the level of confidence of the data (5). Furthermore, the height of the anemometer for the different stations is not the same and hence correction of the data should be carried out before proceeding with further estimations.

The collected data by the EEA covered almost one year and presented in tables or figures (3). Recently the PNL (Pacific North West Laboratory, USA) is conducting a Wind energy assessment program jointly with EEA in which 6 selected sites are equiped with wind resource instrumentation and located on the Red sea and Mediterranean sea coasts, the Mea-

A MODEL TO ESTIMATE WIND POWER AT SELECTED SITES IN EGYPT

Dr. El-Mallah, A.A.* Dr. Shalaby, M.A. Eng. Badr, M.A.*****

ABSTRACT:

A procedure to estimate the average power obtained from a wind energy conversion system is investigated. The procedure calls for fitting a statistical model to the wind speed data and then the selection and application of an appropriate wind speed-power transformation. The two parameter Weibull distribution is used to fit a model to the collected wind speed data. Two methods are used to estimate the Weibull parameters, where the best fitted parameters are then corrected to a specified anemometer height. The best fitted and corrected Weibull parameters are tabulated for most of the promising sites in Egypt., in Sinai, on the North coast, and on the Red Sea coast.

The fitted statistical model is used to estimate the average output power of wind turbine analytically by two methods. Example calculations are given for six selected sites using wind speed data from different sources. The present procedure is usefull when evaluating expected power at a given site, and also when differentiating between promising and less promising sites.

INTRODUCTION:

Wind machines may be used in one of two modes of application with respect to the type of load to be connected to the machine. In the first mode, Fig. 1, it is important to collect a certain amount of energy from the machine over a given period of time.

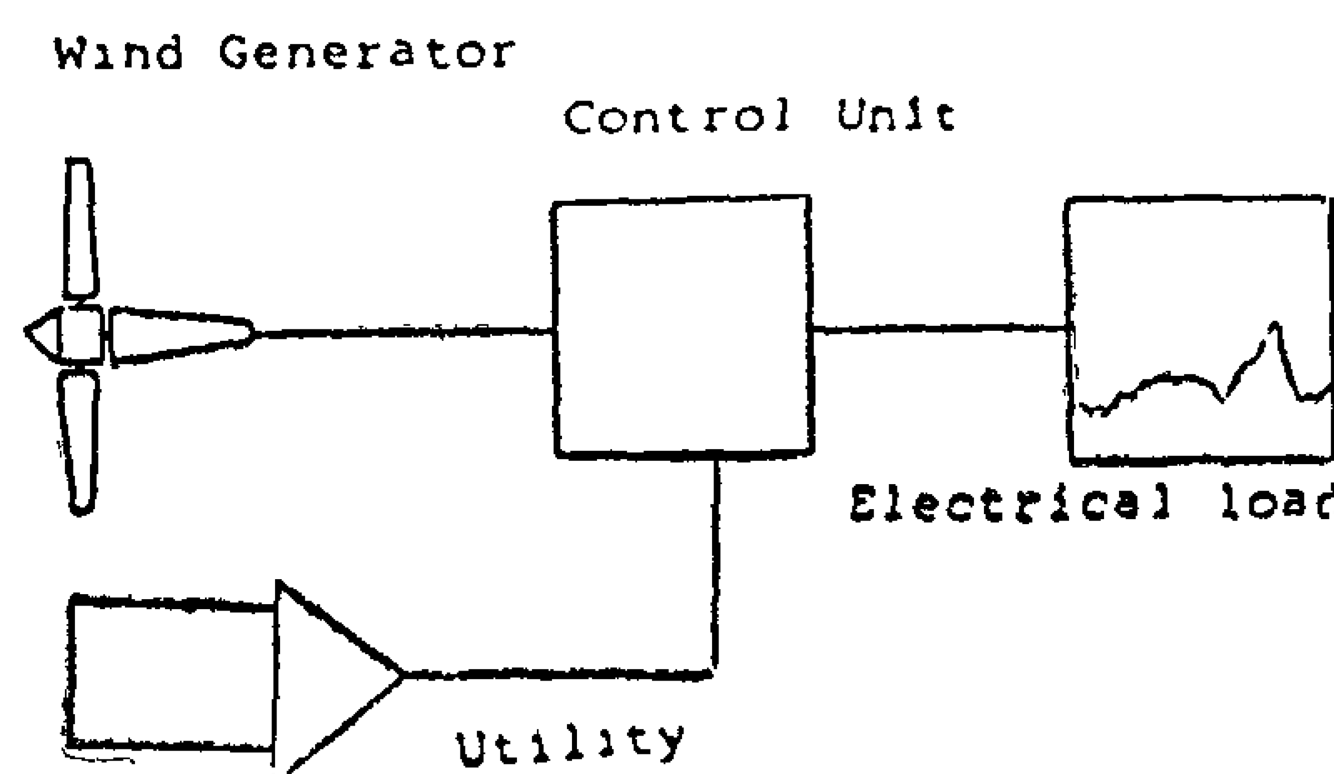


Fig. 1: Wind turbine generator connected to the grid

In this case there is no need to meet a certian load distribution at a specific time since the machine is connected to a utility grid and used as a pay-back means to minimize the cost of energy. The power output in this case should be maximized independently on the diurnal or daily wind distribution.

In the second mode, a case an isolated location, where the power source is a stand-alone system, Fig. 2, the output of the machine should be matched to meet a certain load demand in which a power back-up unit, a battery bank or a small diesel generator, may be used to interact with the system in such a manner to accept excess power from the machine in high winds and deliver power to the load in peak periods or days with calm. The hour by hour load demand and the diur-

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CONCLUSION

A Rankine cycle has been proposed to recover waste heat from an internal combustion engine to supercharge the cylinders by means of a ffreon-113 turbocharger. The advantages of this new system of supercharging have been discussed. It seems that a better overall cycle effiriency for the engine can be obtained. The different parameters which effect the efficiency of the Rankine cycle were studied. It has been demonestrated that the engine exhaust gas temperature and exhaust mass flow rate have a very strong influence of the turbine power and thus on the compressor pressure ratio. A radial turbine was chosen for the freon-113 turbocharger for its simplicity and efficiency. On the basis of cycle optimization, freon-113 was found to be the most suitable one for such small power generation. It is evident that the turbine power, freon mass flow rate and compressor pressure ratio increases with the increase of the utilizing part of the motor cooling water heat.

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NOMENCLATURE

c	absolute velocity
cp	specific heat at consyant pressure
f	fuel
h	enthalpy
Δh	enthalpy difference
γ	specific heat rate
m	mass flow rate
p	power
t	temperature
Δt	temperature difference
u	pripheral velocity
η	efficiency
ν	speed ratio (u/c)
Π	compression ratio

Subscripts

air	air
c_u	compressor
co	condenser
cw	cooling water
ex	exhaust
i	inlet
t	turbine
th	thermal

Superskripts

μ $(\gamma - 1)/\gamma$

Figure 7 gives the values of turbine output power for different turbine efficiencies and for a constant value of pressure ratio ($\Pi_t = 7$). Figure 7 based on a condenser temperature of 38°C, exhaust temperature of 600°C and exhaust mass flow rate of 0.15 kg/s. It is evident that for a determinate thermal cycle efficiency, the output power increases with the increase of the motor cooling water heat part utilized.

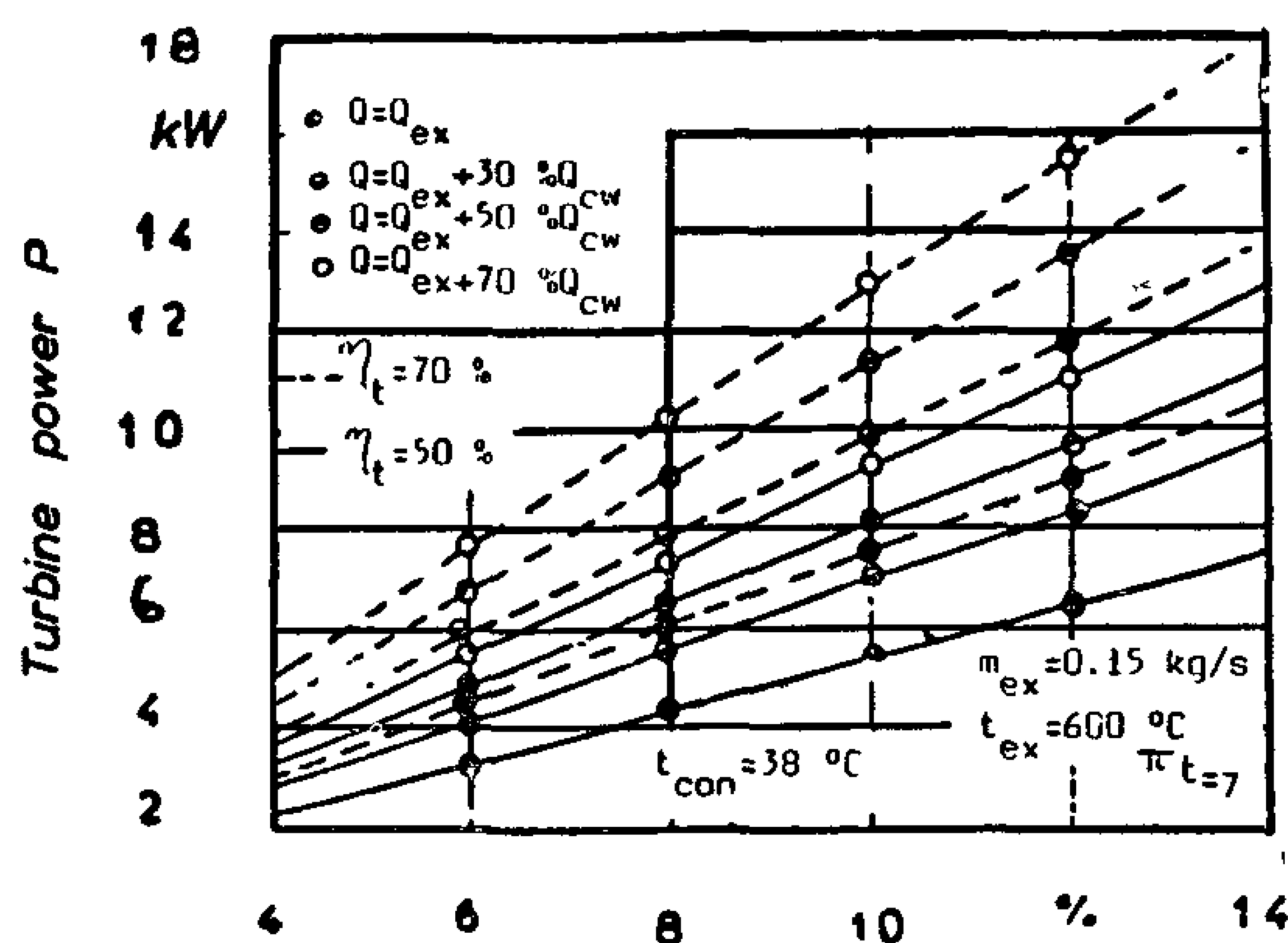


Fig. 7 The values of turbine output power for different turbine efficiencies and for a constant value of turbine pressure ratio ($\Pi_t = 7$).

Figure 8 shows the effect of turbine pressure ratio Π_t on the thermal cycle efficiency η_{th} It can be noticed that for a constant turbine efficiency, the thermal efficiency increases with the increase of turbine pressure ratio.

TURBINE SELECTION AND DESIGN

Turbines for such small power ranges (1-10 kW) are not of the conventional type and require special design. In this work radial turbine was chosen as it is easier to fabricate and as the result of general development in this field, are capable to giving stage efficiencies as high or even higher than those of axial turbines[7]. The radial small turbines involve a small degree of reaction (due to the centerfugal forces) but this still leaves the pressure in which the turbine rotates (causing disc friction losses) very law. In this work a radial turbine from AERODYNE DALLAS which is used in aerodyne turbocharger (MODEL 2.66) is used; as its dimensions give good agreement with the theoretically designed turbine.

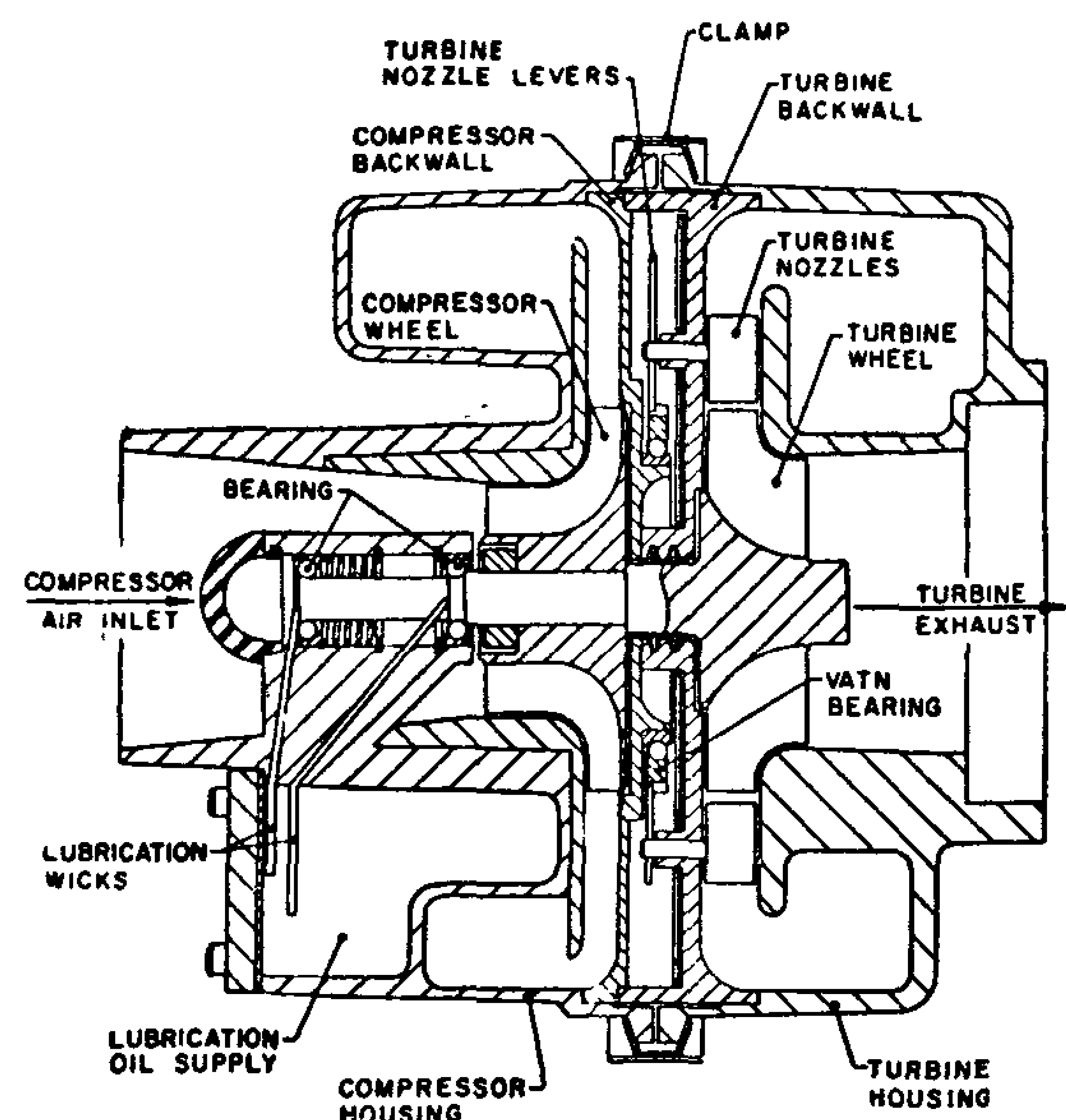


Fig. 8 The effect of turbine pressure ratio on thermal cycle efficiency.

Figure 9 shows the complete freon-113 turbocharger. The radial compressor, the radial turbine and nozzles are shown in the above mentioned figure.

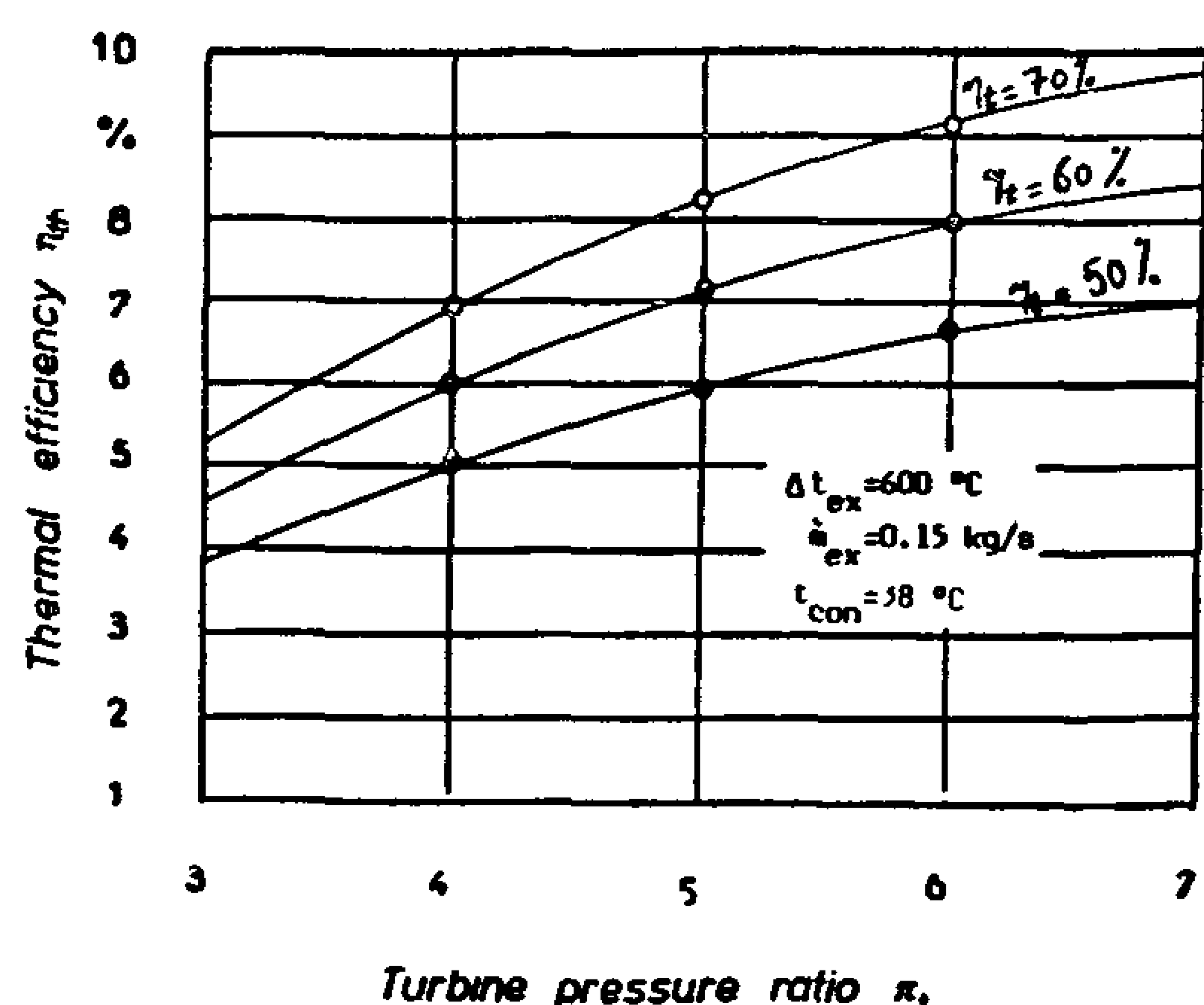


Fig. 9 The complete Freon-113 turbocharger

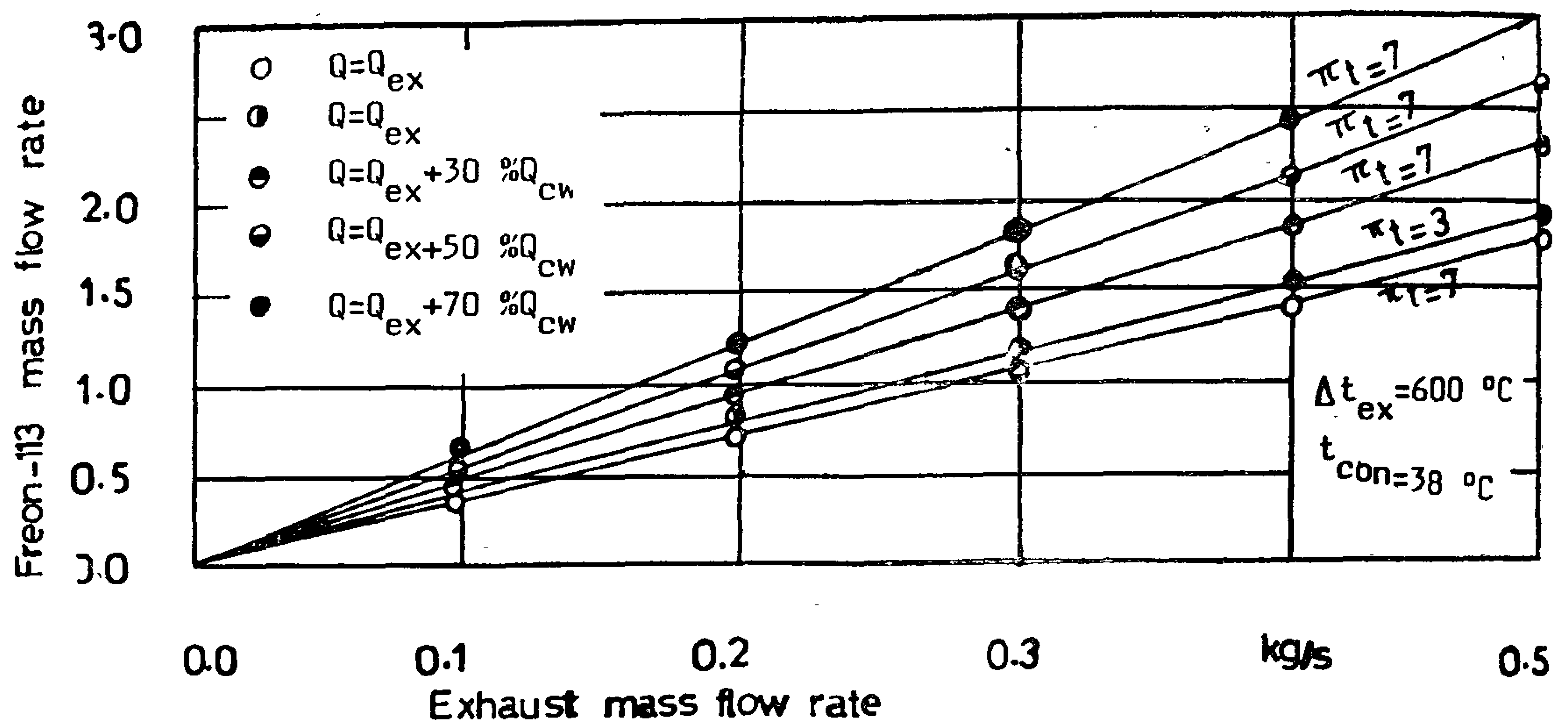


Fig. 4 Freon-113 mass flow rate for differebt turbine pressure ratio and different values of the utilizing cooling water heat heat

The effect of turbine efficiency on thermal efficiency and compressor pressure ratio was also studied and the results are presented in figures 5 & 6. It seems that the thermal efficiency & compressor pressure ratio are both increase with the increase of the turbine efficiency. This may be explained by the fact that the increase of the turbine efficiency results in a high turbine output power which leads to a higher compressor pressure ratio. From the above two curves it is evident that the increase of the utilizing part of the motor cooling water heat increases the compressor pressure ratio for a certain value of the thermal cycle efficiency.

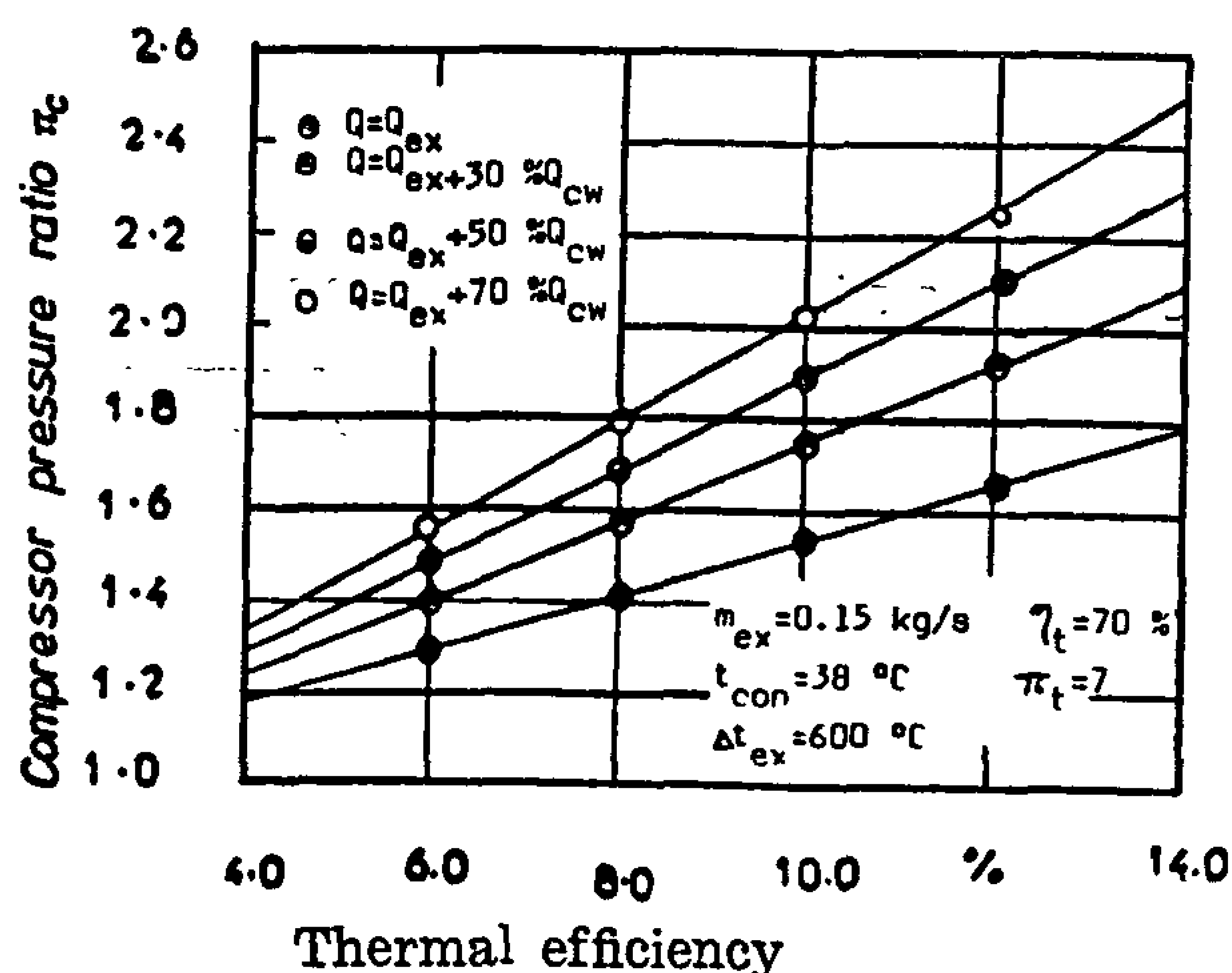


Fig. 5 The effect of turbine efficiency on the thermal cycle efficiency and compressor pressure ratio (η_t =70 %).

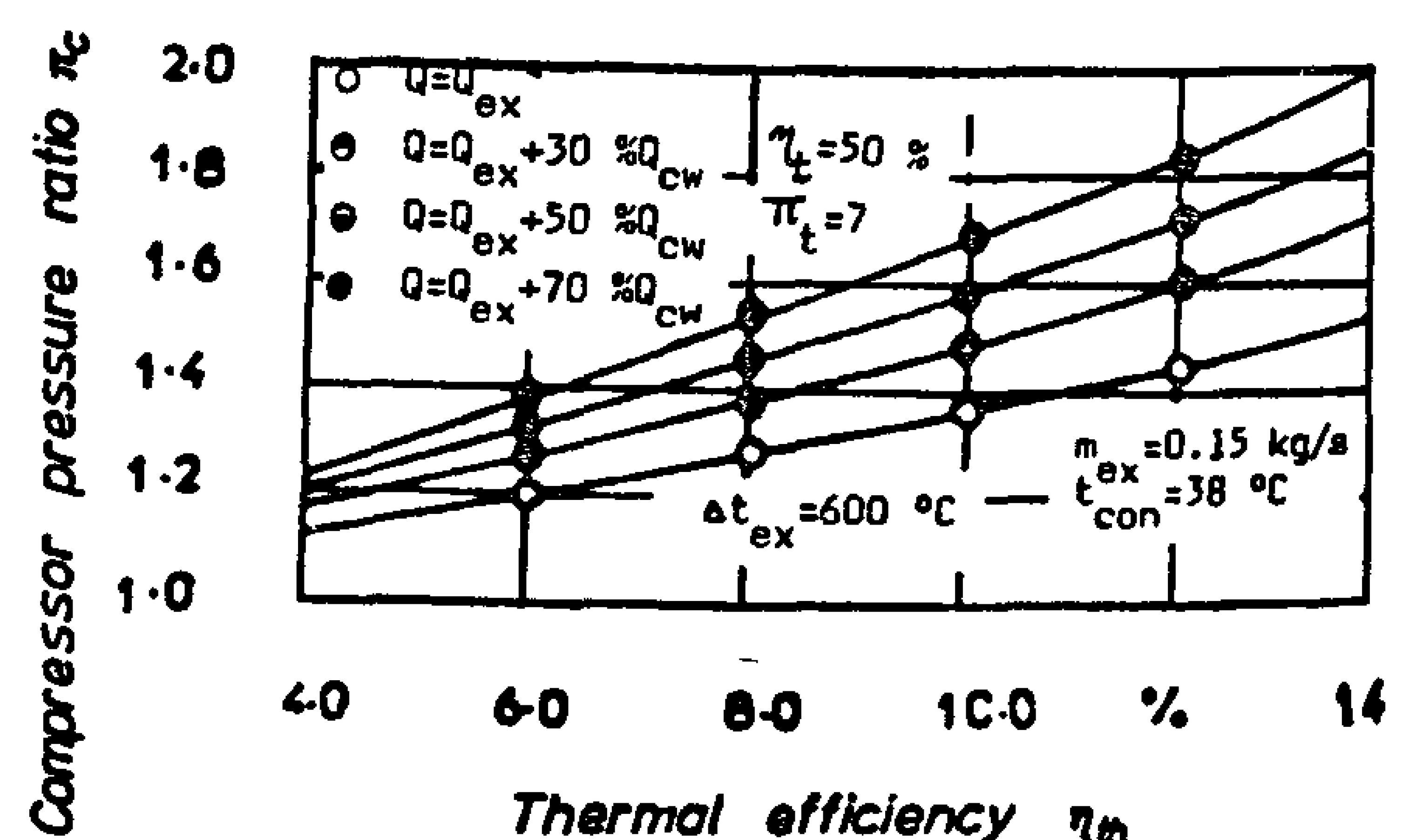


Fig. 6 The effect of turbine efficiency on the thermal cycle efficiency and compressor pressure ratio (η_t =50 %)

	R11	R12	R113	R114
Molecular weight(g/mol)	137.4	120.9	187.4	170.9
Boiling point(°C)atlbar	23.7	-29.8	47.7	3.5
Critical temperature(°C)	198	112	214.1	145.7
Critical pressure(bar)	43.7	41.2	34.1	32.8
Evaporator pressure at -15°C(bar)	0.197	1.8	0.07	0.476
Condenser pressure at 30°C(bar)	1.24	7.35	0.53	2.38
Specific heat ratio at30°Cand lbar	1.14	1.14	1.09	1.08
Stability(toxic decomposition products)	yes	yes	yes	yes
Isentropic enthalpy drop*	34.6	23.4	30.8	24.9
Flamable or explosive %by volume	not	not	not	not

* **Expansion from saturation state at 100 °C to condenser temperature of 30°C.**

Table 1 Comparative characteristics of common refrigerants

Figure 4 shows the effect of turbine pressure ratio on th freon-113 and exhavst mass flow rates. The exhaust gas enters the heat exchanger of the primary water cycle (the exhaust gas thermal energy absorbed by water) with a temperature of 900°C and leaves it with 300°C. The absorbed thermal energy is transfer by means of heat exchanger to the secondary cycle which has freon-113 as a working fluid. The condenser temperature is 38°C and uses air as a coolant. From the above curve it can be seen also that for a constant value of exhaust mass flow rate, the corresponding freon mass flow rate increases as the utilizing part of the motor cooling water heat increases. It can be also noticed from the figure that the turbine oressure ratio in the range of 3-7 has a slight effect on the freon mass flow rate (at constant exhaust gas inlet and outlet temperature).

SELECTION OF THE WORKINK FLUID

A study of the thermodynamic properties of varies substances indicate that organic fluids with higher moleculr weights have many advantages as working fluids for small power units; compared with water which has been extensively used as a working fluid. For such small tubines the expansion should take place in one stage as the use of two stage pressure or velocity compounded turbine is more complicated and expensive. To attain high cycle efficiency for small capacity power systems, tthe enthalpy drop should be as high as possible. This results in low mass flow rate which necisitates the use of partial admission usually associated with low efficiency. The necisty of using organic fluid cycle rests on the fact that the steam is of low molecular weight (m = 18), and this results in high nozzle velocities even for a modest temperature drop achived by expansion throuyh a turbine. This may be expressed by[3], [4].

$$c \propto \frac{1}{\overline{M}} \qquad (1)$$

It can be seen that from equation (1) that if a fluid of suitable molecular weight is chosen (i.e several times that of steam), the nozzle velocity is reduced and the enthalpy drop per unit mass is decreased. Thus it is possible to achieve full admission and a good efficiency as the speed ratio (ν = u/c) is increased[5]. Another important creterion is that the fluid should have a relatively low heat of vaporization for this would have a major influence on the heat required. The other factors considered were work factor, thermal stability, corrosivity, flammability and toxicity. Two fluids were however found to satisfy the screening cretera. They were Aceton and Freon-113 [4]. Freon-113 was found to be the best choice for this application as Aceton is a highly flammable liquid. Another important characteristic of this fluid is the slope on the temperature entropy diagram. This fact yields superheated vapour after expansion from the inetially saturated state. Thus eliminating practical problem in turbine occures due to the presence of liquid. Table 1 gives a comparative characteristics of common refrigerants[6]. It can be deduced, hence, that freon-113 gives the highst Rankine cycle efficiency, low evaporator and condenser pressure.

SYSYEM THERMODYNAMICS

Figure 3 shows the p,h diagram for freon-113. From that curve it can be seen that.

$$P_t = m_v \times (h_o - h_1) \times \eta_t \qquad (2)$$

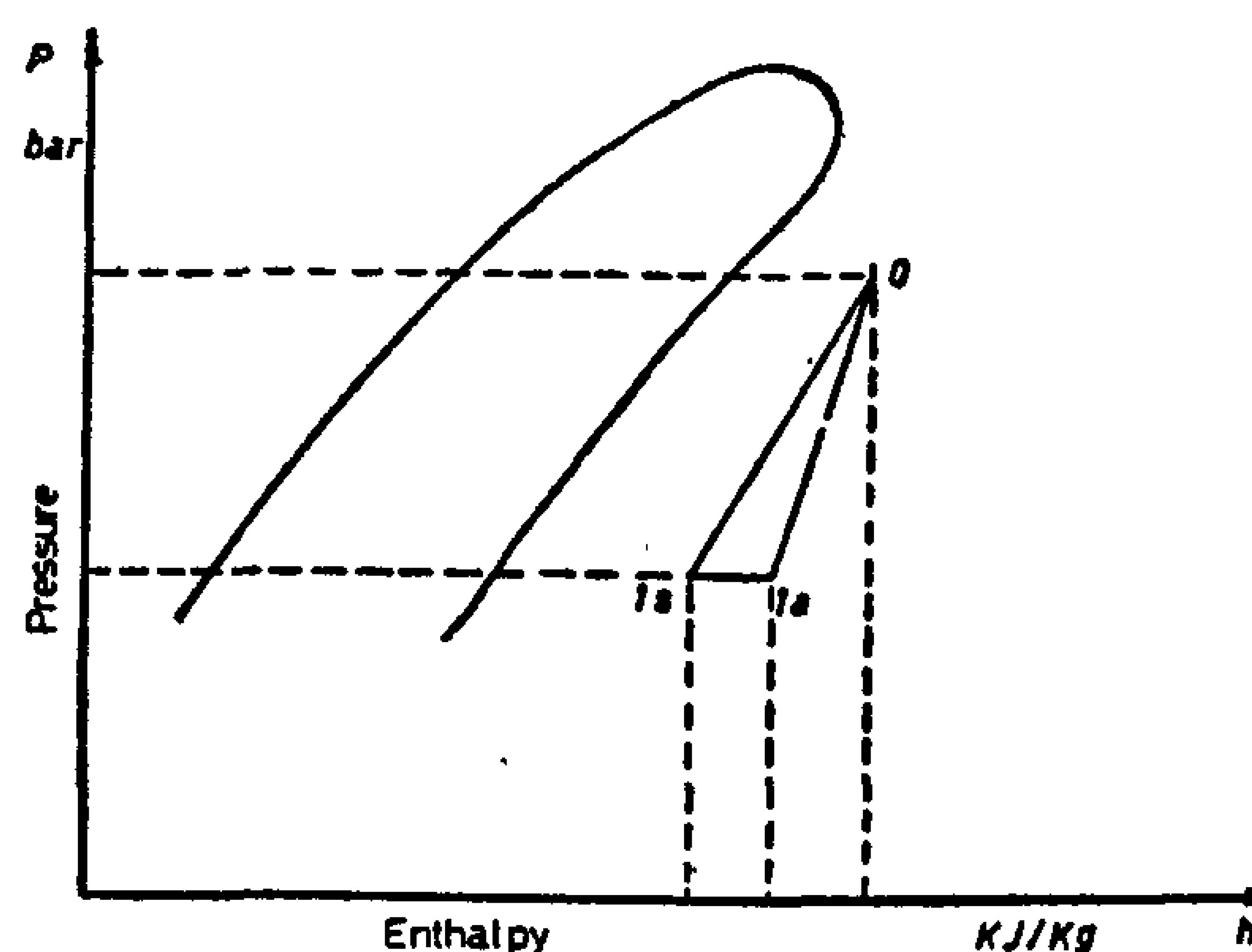


Fig. 3 P-h diagram fo. reon-113

The turbine output power is used to drive the radial compressor, which supercharges the engine cylinders. The compressor power is defined as;

$$P_c = m_{air} \times \Delta h_c \qquad (3)$$

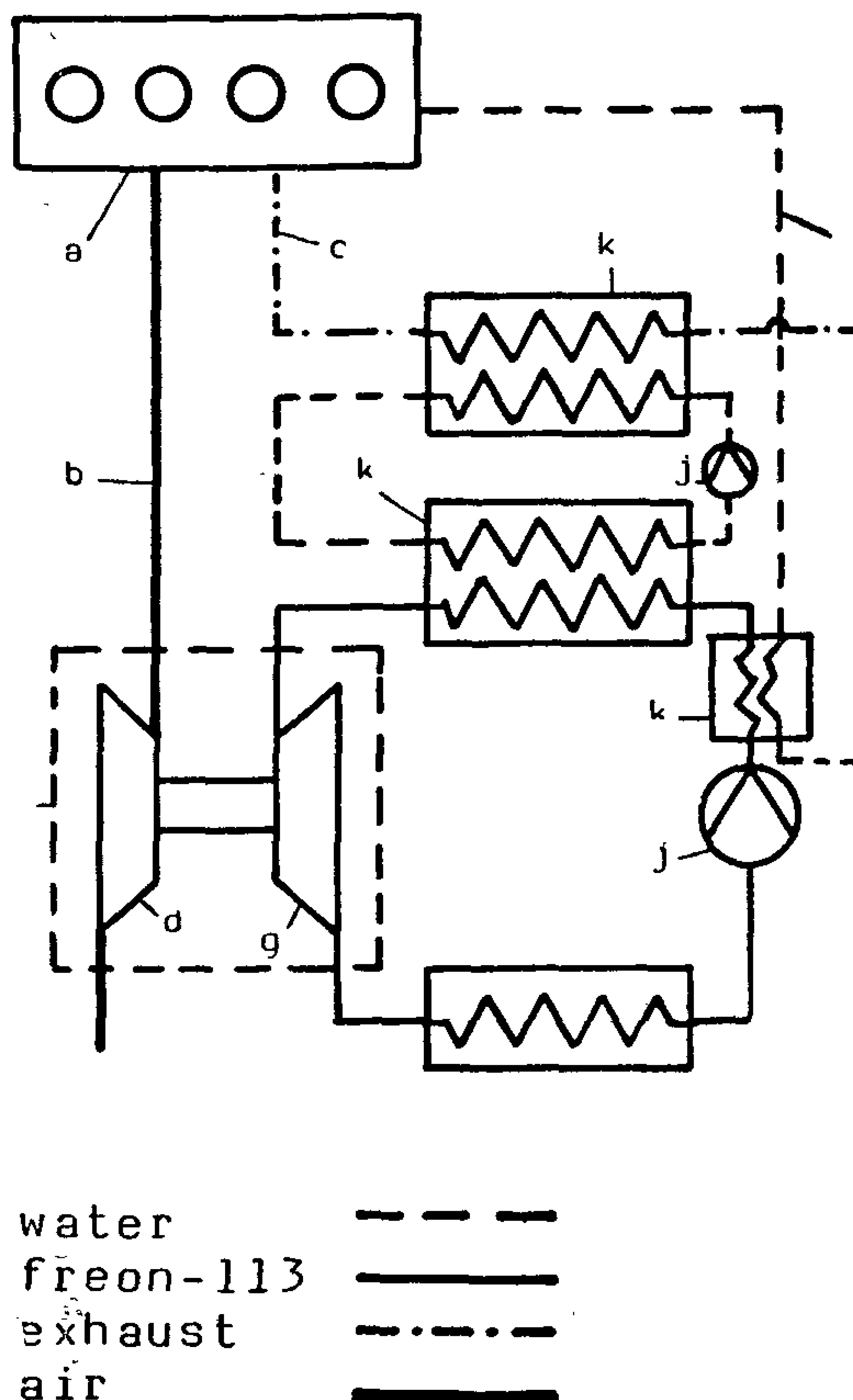
This equation can be rewritten in terms of compressor pressure ratio and the air inlet temperature T c,i as;

$$P_c = m_{air} \times cp_{air} \times T_{c,i} (\pi_c^{\mu} - 1) / \eta_c \qquad (4)$$

The fuel air ratio for petrol engines is about 1/14.5. It is well known that the turbine power must be equal to the compressor power in the turbocharger; assuming that mechanical losses are negligible. This leads to;

$$\pi_c = \left(\frac{15.5 \times P_t \times \eta_c}{14.5 m_{ex} \times cp_{air} \times T_{c,i}} + 1 \right)^{1/\mu} \qquad (5)$$

evident that the freon turbocharger system uses the thermal energy from the exhaust gases by means of a primary water cycle and a part of the motor cooling water heat for producing freon-113 vapour by a heat exchanger with low exhaust gas pressure loss. This vapour expands in a small radial turbine to produce the requred power for the compressor. The advantage of using this freon turbocharger system can be seen from fig. 2 which represents the p,v diagrams for two types of engines. The first type (fig. 2A1,2A2) is supercharged by means of a conventional turbocharger and the second type (fig. 2B) by means of freon-113 turbocharger. The effect of exhaust gas pressure and boost pressure during the charging process on the pumping loop when using a conventional turbocharger can be noticed from fig. 2A1 and fig. 2A2. It is clear that the pumping loop in the p,v diagram is positive when the exhaust gas back pressure is lower than the boost pressure, and it is negative when the exhaust gas back pressure is higher than the boost pressure; and this later occures under full load or high engine speed ranges. In the case of using a freon-113 turbocharger the engine operates only with a postive pumping loop over the whole operating ranges. This is because the vapour generator does not represent any resistance to the flow in the exhaust flow path; so that the exhaust gas back pressure is almost atmospher.



a- engine
b- compressed air
c- exhaust gas
d- compressor
g- freon-113 turbine
h- freon-113 turbocharger
i- condenser
j- pump
k- heat exchanger
l- motor cooling water

Fig. 1 freon-113 turbocharger system

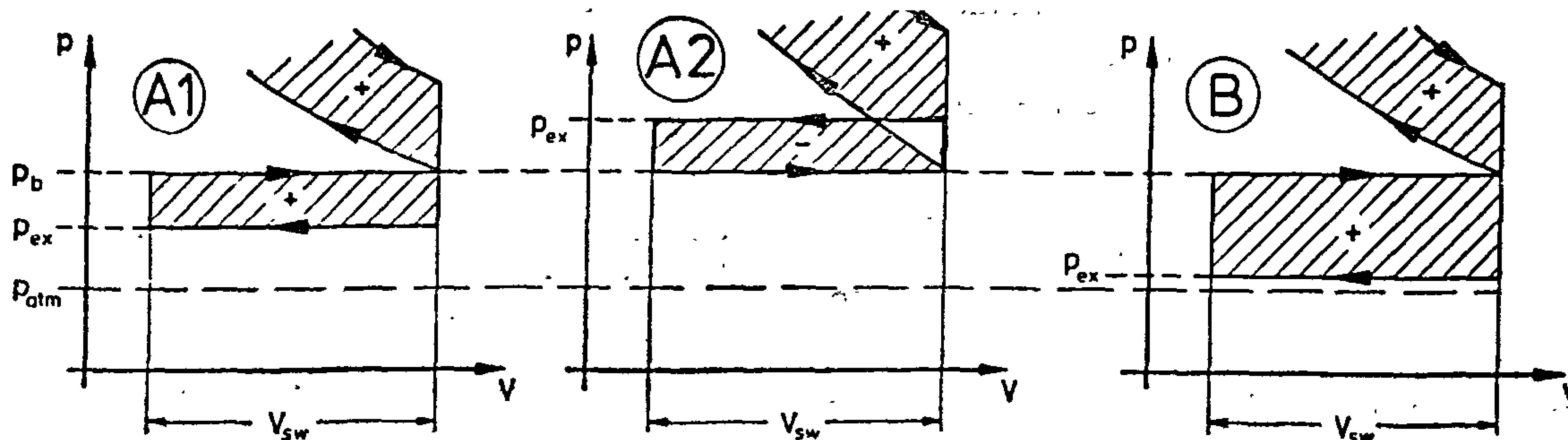


Fig. 2 Different pumping loops in p,v diagram for

A1) an engine supercharged by a conventional turbocharger(positive pumping loop)
A2) an engine supercharged by a conventional turbocharger(negative pumping locp)
B) an engine supercharged by a Freon6113 turbocharger

THE DESIGN OF AN EXHAUST MAINFOLD SYSTEM TO IMPROVE TURBO-CHARGER PERFORMANCE

Dr. M. Abdel Kader*

ABSTRACT

The raise of fuel costs are forcing engineers to re-examine their practice in order to recover useful power from the waste heat of piston engines. After reviewing this heat source and the potential value of this heat for power generation, a Rankine cycle is proposed to match the above mentioned heat source. In this case the thermal energy in the exhaust gas and a part of the cooling water heat can be used to vaporise the working medium in a heat exchanger. The generated vapour then expands in a turbine. The turbine is connected with radial compressor AERO-DYNE (MODEL 2.66) from AERODYNE DALLAS which is used in turbocharged gasoline engines. The advantage of using this new system of supercharging over the conventional exhaust gas turbocharger; is to avoid the mechanical loss due to the raise of exhaust gas back pressure with the increas of engine speed, and hence decline the specific fuel consumption. To use ths new method there are two problems. The fist one is to choice the most suitable working fluid for the Rankine cycle. The second one is to select the appropriate type of turbines for such small power (1-15 kW). In the case of using steam as a working fluid, a partial admisson turbine must be used; as the mass flow rate is small in order to attain a high thermal cycle efficiency. The use of partal admission is usually associated with low efficiencies. To avoid the use of partial admission, in the present work a comparison between different organic fluides were made to choice the suitable one for the cycle. On the basis of cycle optimization, freon-113 was found to be the most suitable one for such small power generation.

INTRODUCTION

The use of exhaust gas turbocharger for internal combustion engines is usually accompanied by mechanical loss. This loss is due to the raise of exhaust gas back pressure with the increase of engine speed. This back pressure prevents the discharge of the exhaust gas from the engine cylinders and causes mechanical loss. To avoid this undesirable phenomenon, a Rankine cycle is used. In this case the thermal energy in the exhaust gas is used to heat water in a primary water cycle. The heated water then vaporise freon-113 in a heat exchanger. A part of the motor cooling water can be utilized to improve the efficiency of Rankine cycle by means of a heat exchanger as shown in fig. 1.

The generated freon vapour expands in a turbocharger which supercharges the engine cylinders. A small radial turbine has been chosen. The expected output power for this small turbine is 10kW[1]. Freon-113 flows to the condenser and then pumped back to the freon-113-water heat exchanger to complete the Rankine cycle[2].

Fig. 1 shows a schematic diagram for the proposed Rankine cycle for freon turbocharger which can be used in stationary engines or motor vehicles. It is

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(2) It is clear, from the results of the investigated system, that the proposed algorithm is capable to eliminate the overload in power systems without or with minimum load shedding

(3) Although the success of the proposed technique for dealing with the optimal control of overload relief devices in power systems, this technique as all nonlinear programming techniques takes long computational time. This drawback opens up new area for investigating the linearized phase of the problem especially from the accuracy point of view.

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Table (III)

Limiting values of the problem variables.

Bus code i	Genaration P_{max} P.U.	P_{min} P.U.	Q_{max} P.U.	Q_{min} P.U.	E_{max} P.U.	E_{min} P.U.	Q_{Nmax} P.U.	Q_{Nmin} P.U.
1	1.0	0.30	0.2	0.0	1.06	1.06	-	-
2	2.0	0.20	0.2	0.0	1.06	1.00	-	-
3	2.5	0.15	0.2	0.0	1.06	1.00	-	-
4	-	-	-	-	1.06	1.00	0.2	-0.2
5	-	-	-	-	1.06	1.00	0.0	-0.2

The limiting value of $\Delta \phi_{ij}$ is $\pm 5^{o}$.

Table (IV) shows the currents flowing in the different branches after tripping branch (2-4).

Table (IV)

Loading profile of the 5-node network after tripping branch (2-4).

Line code i-j	I_{ij} P.U.	I_{max} P.U.	Line code i-j	I_{ij} P.U.	I_{max} P.U.
1-2	0.75843	1.20	4-3	0.38291	0.8
1-3	0.45207	0.40	4-5	0.04119	0.6
2-1	0.75507	1.20	5-2	0.61181	0.9
2-3	0.35844	0.45	5-4	0.04706	0.6
2-5	0.60713	0.90	3-1	0.45780	0.4
3-2	0.36751	0.45	3-4	0.38279	0.8

It is clear that line (1-3) is overloaded by 14.736% over loading.

By using a nonlinear programming technique(4) to find the optimal load shedding on the above system, without using any additional overload relief devices,, it is found that the required load shedding is (0.14479 + j 0.0483) p.u. from bus 3.

Applying the proposed technique on the same sample system, the optimal values of the problem variables are shown in table V.

Table VI gives the loading profile of the network after adjusting the overload relief devies according to the optimal solution.

Table (VI)

Final loading profile of the 5-node network

Line code i-j	I_{ij} P.U.	I_{max} P.U.	Line code i-j	I_{ij} P.U.	I_{max} P.U.
1-2	0.78243	1.20	3-2	0.42853	0.45
1-3	0.39800	0.40	3-4	0.39959	0.80
2-1	0.78031	1.20	4-3	0.39976	0.80
2-3	0.36964	0.45	4-5	0.02156	0.60
2-5	0.61193	0.90	5-2	0.61993	0.90
3-1	0.40000	0.40	5-4	0.02186	0.60

From tables II, V, VI, it s clear that the proposed technique succeded to relieve the overload using the power system reserve capacities with no need to load shedding.

Conclusions

(1) The paper gives a complete problem formulation for the optimal control of overload relief devices in power systems as a nonlinear programming problem taking into consideration all the reserve capacities in the system.

Table (V) Optimal values of the problem variables.

Code	P_G p.u.	Q_G p.u.	P_L p.u.	Q_L p.u.	ΔQ_N p.u.	$\Delta \phi_{ij}$	E_i p.u.	δ red.
bus 1	0.6914	0.057	-	-	-	-	1.06	0.0
bus 2	0.53	0.110	0.3	0.1	-	-	1.0493	-.04515
bus 3	0.45	0.183	0.45	0.15	-	-	1.0264	-.08382
bus 4	-	-	0.4	0.05	0.023	-	1.02407	-.1186
bus 5	-	-	0.6	0.10	-	-	1.0545	-.11757
Line 1-3	-	-	-	-	-	-3^{o}	-	-
Line 2-3	-	-	-	-	-	$+2^{o}$	-	-

I_{ij} magnitude of the current flowing from bus (i) to bus (j),

ϕ_{ij} angular setting of phase shifter,

ΔQ_N injected reactive power,

W_i weighting factor associated with the load at node (i) reflecting its importance,

$W_{a,b,c,d}$ weighting factors associated with phase shifting transformers, injected reactive power, generated reactive power, and economic shift in generation, every one of them reflecting its selecting priority.

The problem variables are:

$$P_{Li}, Q_{Li}, P_{Gi}, Q_{Gi}, \Delta Q_{Ni}, \Delta\phi_{ij}, E_i, \delta_i$$

Solution algorithm:

1) An A.C. load flow is used for the considered emergency condition to enumerate the deviations of the system operating conditions from their permissible limits.

2) The nonlinear programming computation adopting the (SUMT) (5) algorithm determines the locations and amounts of the problem variables.

Numerical example:

The system shown in Fig. (1) is attempts at modelling full scale system, with actual line impedances used and with lumping of smaller bus loads so as to reduce the total number of buses.

Table (1) gives the impedance data of the network in p.u. on a 220 kV, 100 M.V.A. base, maximum permissible currents and maximum permissible phase angle differences of the 5-node network.

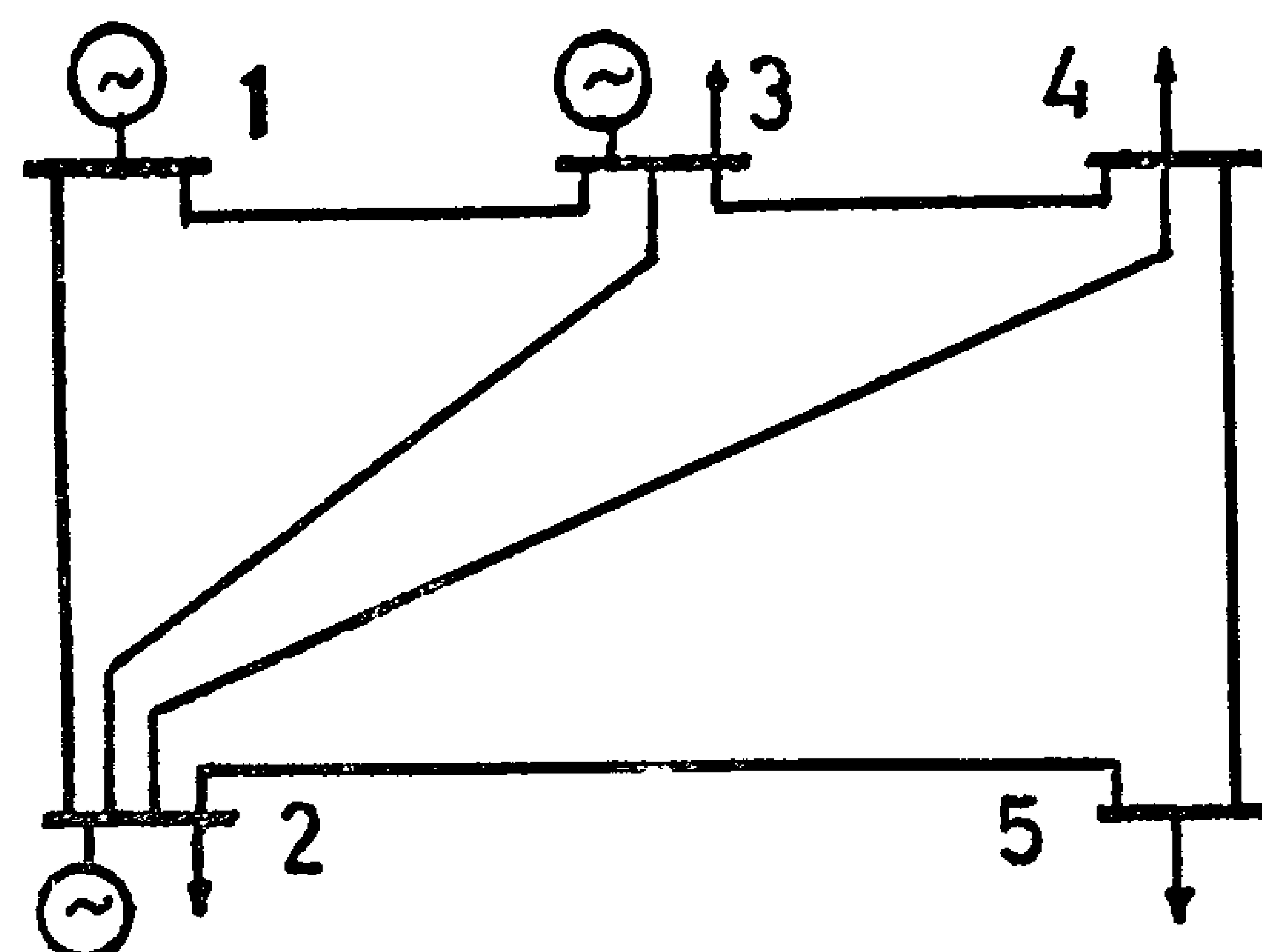


Fig. (1) Single line diagram of the 5-node network

Table (1)

Impedances, line charging, maximum permissible currents and phase angle differences of the 5-node network.

Bus code i-j	Impedance Z_{ij} P.U.	Line charging $Y_{ij}/2$ P.U.	I_{max} P.U.	δ_{ijmax} red.
1-2	0.02+j0.06	0.0+j0.030	1.200	0.5236
1-3	0.08+j0.24	0.0+j0.025	0.399	0.5236
2-3	0.06+j0.18	0.0+j0.020	0.450	0.5236
2-4	0.06+j0.18	0.0+j0.020	0.450	0.5236
2-5	0.04+j0.12	0.0+j0.015	0.900	0.5236
3-4	0.01+j0.03	0.0+j0.010	0.800	0.5236
4-5	0.08+j0.24	0.0+j0.025	0.600	0.5236

Table (II) lists the scheduled generations and loads at the different buses.

Table (II)

Generations and loads at different buses of the 5-node network.

Bus code i	Generation P_{Gi} P.U.	Q_{Gi} P.U.	Load P_{Li} P.U.	Q_{Li} P.U.
1	-	-	0.00	0.00
2	0.53	0.070	0.30	0.10
3	0.45	0.125	0.45	0.15
4	-	-	0.40	0.05
5	-	-	0.60	0.10

Table (III) gives the limiting values of the probem variables.

The objective function to be minimized is of the form:

$$F=\sum_{i=m+1}^{n} W_i\left[(P^*_{Li}-P_{Li})+(Q^*_{Li}-Q_{Li})\right]+W_a\sum_{i,j=1}^{R}\Delta\phi_{ij}+W_b\sum_{i=m+1}^{n}\Delta Q_{Ni}+W_c\sum_{i=1}^{m}Q_{Gi}+W_d\sum_{i=1}^{m}F_i(P_{Gi}) \quad (1)$$

where $F_i(P_{Gi})=\sum_{i=1}^{m} a_{1i}P_{Gi}^2+a_{2i}P_{Gi}+a_{3i}$ (2)

Subject to the following equality and inequality constraints:

$I_{ij}\leqslant I_{ijmax}, (i=1,..,n)$ (3)

and $I_{ji}\leqslant I_{ijmax}, (j=1,..,n)$ (4)

where $\hat{I}_{ij}=(\hat{E}_i-\hat{E}_j)\hat{y}_{ij}+\hat{E}_i\hat{y}'_{ij}/2$ (5)

and $\hat{I}_{ji}=(\hat{E}_j-\hat{E}_i)\hat{y}_{ij}+\hat{E}_j\hat{y}'_{ij}/2$ (6)

$|\delta_i-\delta_j+\Delta\phi_{ij}|\leqslant\delta_{ijmax}, (i=1,...,n),(j=1,..,n)$ (7)

$0\leqslant P_{Li}\leqslant P^*_{Li}, (i=m+1,..,n)$ (8)

$0\leqslant Q_{Li}\leqslant Q^*_{Li}, (i=m+1,..,n)$ (9)

$P_{Gimin}\leqslant P_{Gi}\leqslant P_{Gimax}, (i=1,..,m)$ (10)

$Q_{Gimin}\leqslant Q_{Gi}\leqslant Q_{Gimax}, (i=1,..,m)$ (11)

$\Delta Q_{Nimin}\leqslant\Delta Q_{Ni}\leqslant\Delta Q_{Nimax}, (i=m+1,..,n)$ (12)

$E_{imin}\leqslant E_i\leqslant E_{imax}, (i=2,..,n)$ (13)

$\phi_{ijmin}\leqslant\phi_{ij}+\Delta\phi_{ij}\leqslant\phi_{ijmax}, (i,j=1,..,R)$ (14)

$P_i(E,\delta)=P_{Gi}-P_{Li}=\sum_{j=1}^{n}E_iE_jY_{ij}\cos(\delta_i-\delta_j+\theta_{ij}), (i=2...,n)$ (15)

$Q_i(E,\delta)=Q_{Gi}-Q_{Li}+Q_{Ni}=\sum_{j=1}^{n}E_iE_jY_{ij}\sin(\delta_i-\delta_j+\theta_{ij}), (i=2,..,n)$ (16)

where:

P^*_L, Q^*_L active and reactive demand,

P_L, Q_L active and reactive supplied power,

P_G, Q_G active and reactive generated power,

E_i voltage magnitude at node (i),

δ_i voltage phase angle at node (i),

n number of system nodes,

m number of generators,

R number of phase shifting transformers,

OPTIMAL CONTROL OF OVERLOAD RELIEF DEVICES IN POWER SYSTEMS USING NON-LINEAR PROGRAMMING TECHNIQUE

M.M. El-Gazar* S.A. Othman*

Abstract

Overload relief in power systems is a very important system problem that dispatching engineers have to face very often. The optimal solution of such a problem will increase the reliability of power systems.

The aim of this paper is to find the optimal settings of the overload relief devices in power systems, such as, phase-shifting transformers, reactive power sources and economic shift in generation to eliminating/minimizing their overloads.

In the paper, the problem of optimal overload relief in power systems is formulated as a nonlinear programming problem and a new algorithm based on this formulation is suggested.

The suggested algorithm is tested, by application to 5-node network.

Introduction

A power system may be subjected to emergency conditions due to the removal of transmission lines to isolate a fault or for maintenance work, or due to the shutdown of some of its generating stations. If the system survives the outage, it will be operating in a new steady state in which one or more transmission lines may be overloaded.

Continued secure operation of the system involves the determination of a new state in which the system elements are not overloaded. An exact determination of the secure state will considerably improve the operation of the system.

Several trials have been done to develop techniques for overload relief in power systems. These trials may be summarised as follows:

(i) Line overloads are alleviated by shedding some of the interruptible loads[1].

(ii) Line overloads are eliminated by the economic shift in electric power generation[2].

(iii) Line overloads are eliminated using generation rescheduling and load shedding[3].

Therefore, it seems that there is an urgent need for an optimal control of overload relief in power systems which takes into consideration all the reserve capacities in the system.

The suggested algorithm takes into consideration all the reserve capacities in the system, such as, phase shifting transformers, reactive power sources, and economic shifting in generations, so that it is cabable to eliminate the overload in power systems without or with minimum load shedding.

Problem formulation:

The problem of optimal control of overload relief in power systems is formulated as a nonlinear optimization problem as follows:

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are very small and the computations are remarkably accurate. This is a strong evidence supporting the developed method as an improved method for predicting the induction motor performance at the design stage.

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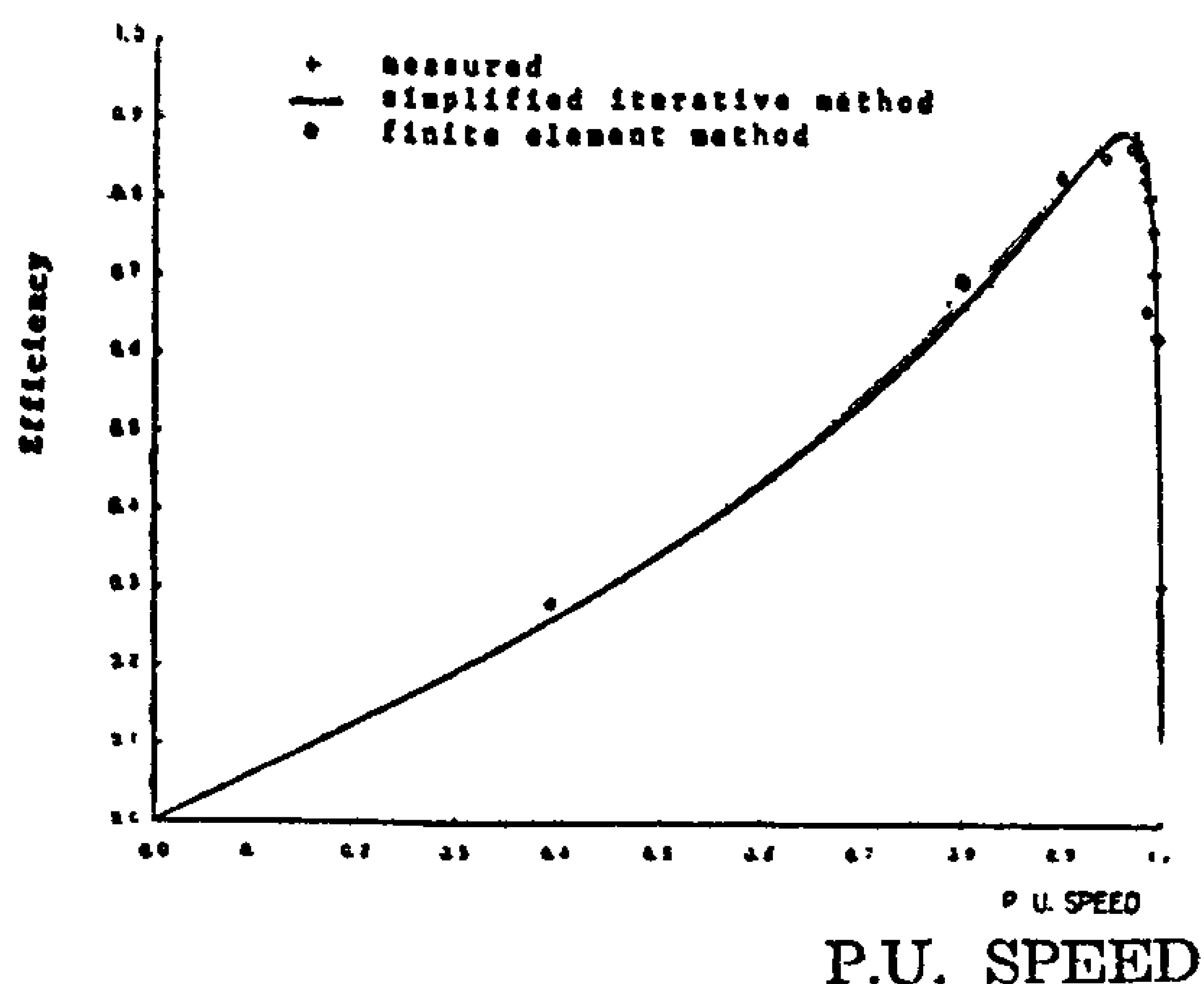
6- Determination of performance characteristics.

The purpose of this section is to predict the steadystate performance in a 3-phase squirrel cage induction motor at any operating condition taking into account the effects of premeability disribution and eddy currents, Induction motor performances customarily specified in term of operation at constant terminal voltage, and as a function of rotor slip.

An induction motor with the following nameplate specification :

3-phase, 4-pole, 15HP, 50HZ, 1440 r.p.m., was considered for a numerical application.

Since the parameters of the equivalent circuit at different rotor frequency are known, it is possible to calculate the power factor, efficiency and torque-slip characteristics. The developed torque is calculated from the rotor losses in the usual manner. Comparisons of performance results computed by the finite element method and the simplified iterative method developed by Brown et al (11) with the results obtained in experiments with an actual motor are illustrated in figs. (5) a,b.



P.U. SPEED

fig. 5-a comparison between the computed and measured efficiency - speed characteristics for single cage motor at 400 v

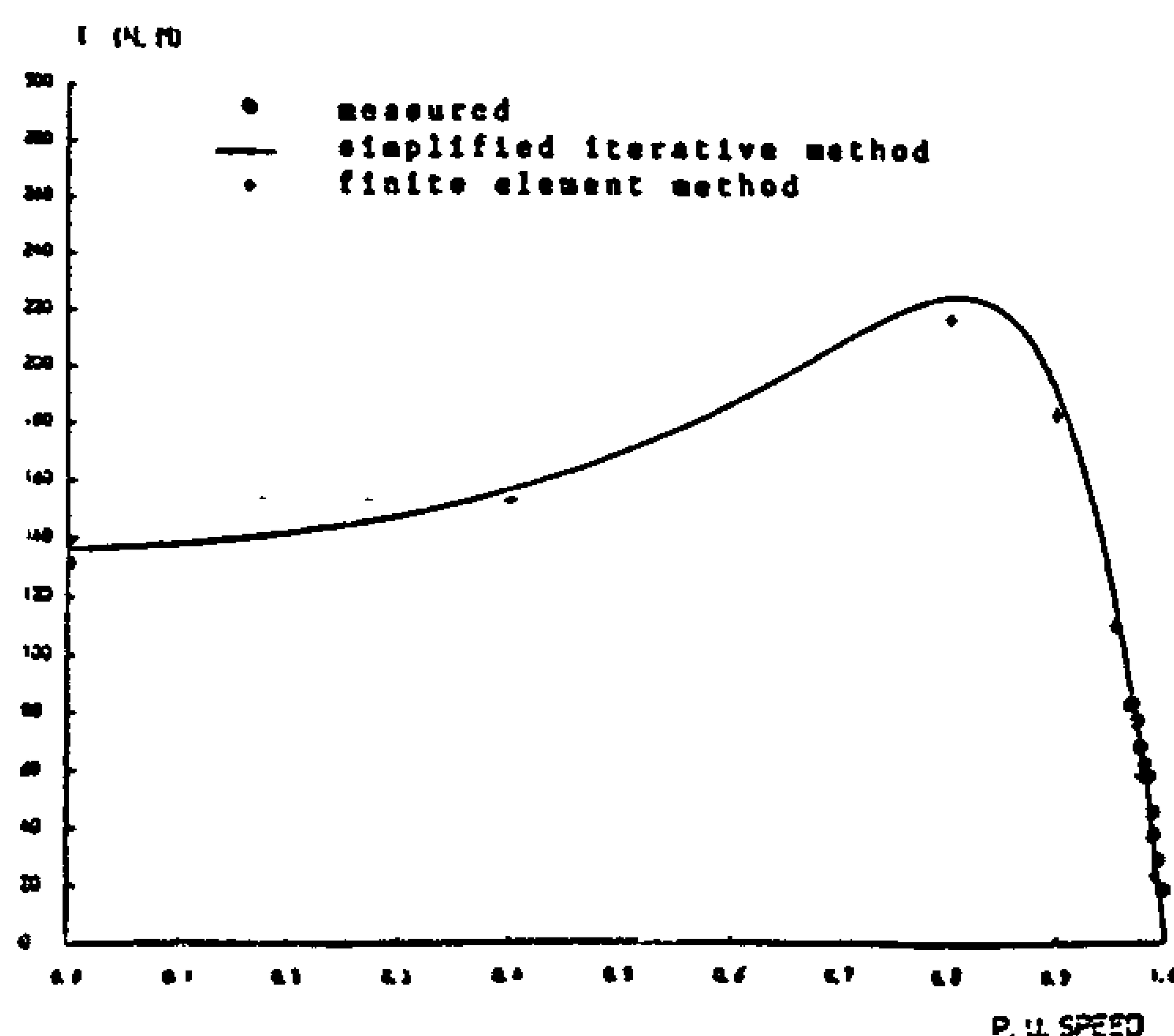


fig. 5-b Torque-speed characteristics for single cage motor at 400 v.

The excellent agreement between the computed and test results verifies the numerical technique developed in this paper

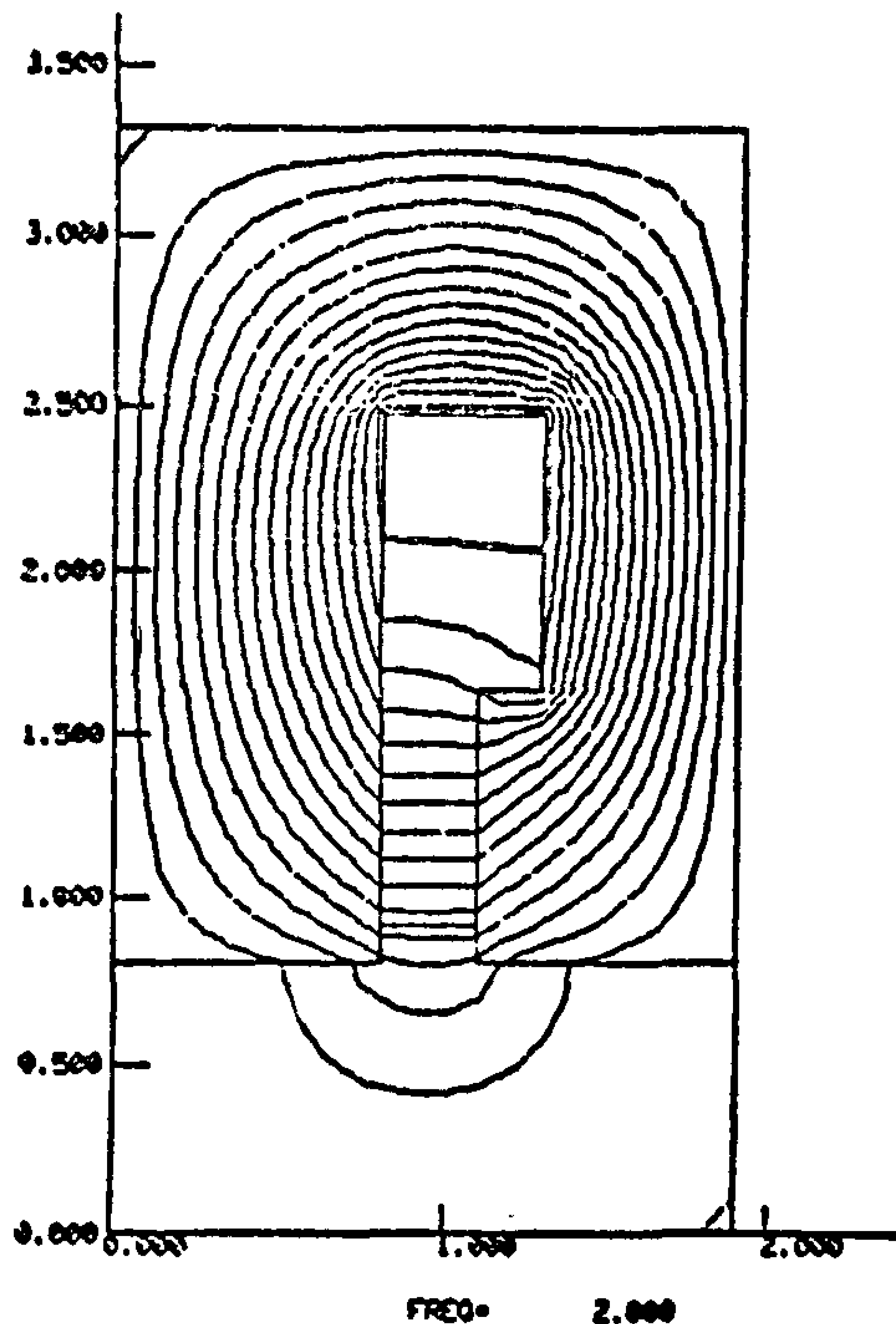
7- Conclusion

This paper has described a general method using the finite element technique for analyzing the magnetic field and calculating the parameters of the equivalent circuit and predicting the performance characteristics, for limited value of permeability of 3-phase induction motors.

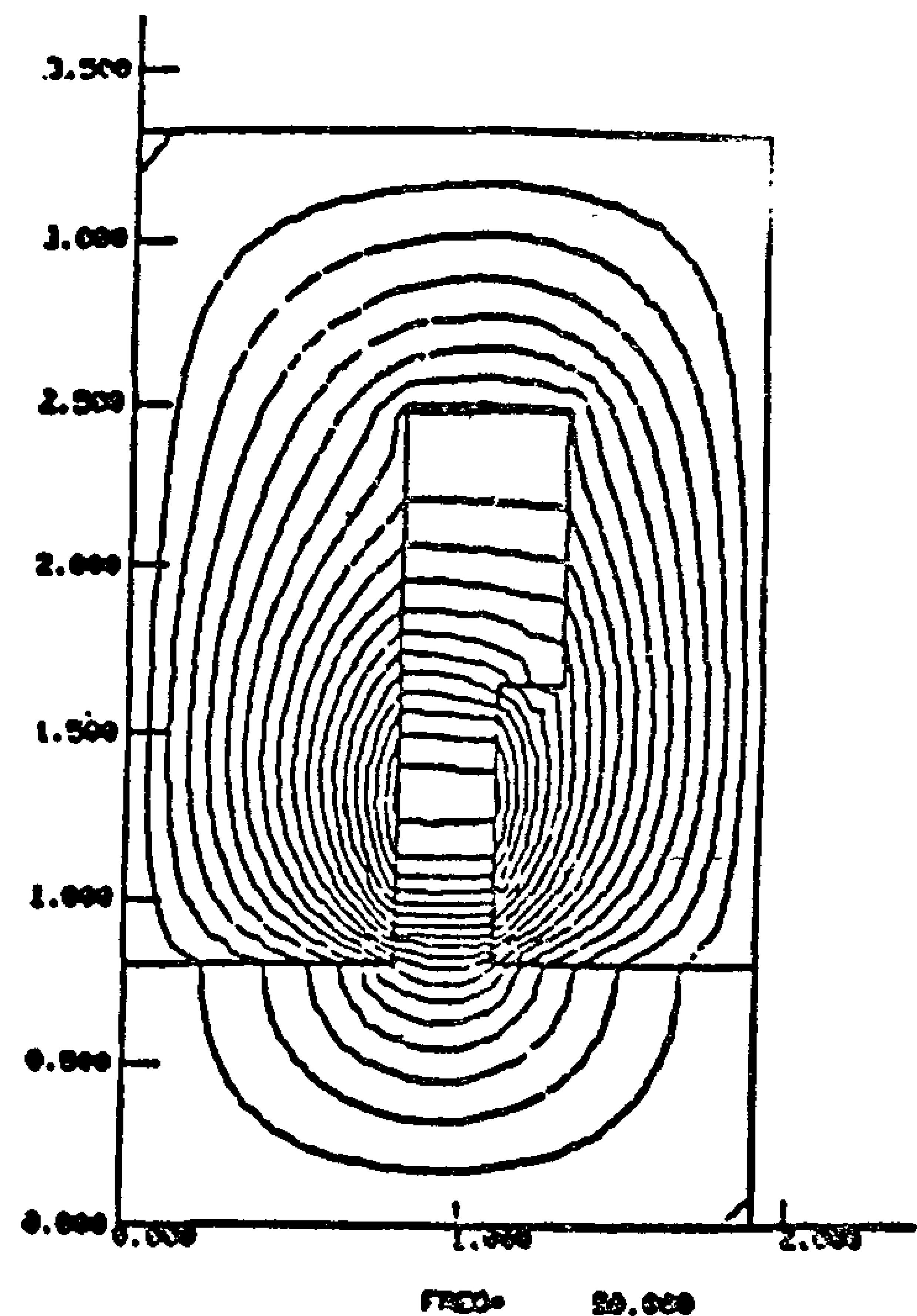
In this paper, the no-load characteristic, the magnetizing and stator slot leakage reactances are calculated by using static electromagnetic analysis solution. The finite element method is applied also for analyzing the magnetic fields using eddy current diffusion analysis to determine the flux and current distribution in the rotor bar and to calculate the slot constants, i.e. the effective bar resistance and slot leakage coefficient, at starting and running for limited values of permeabilities. It can be seen from the results obtained that the differences between the measured and computed values by finite element method and the classical method

The effect of the drop of permeability due to saturation are clearly evident, with the rotor circuit constants falling as the bar current increases.

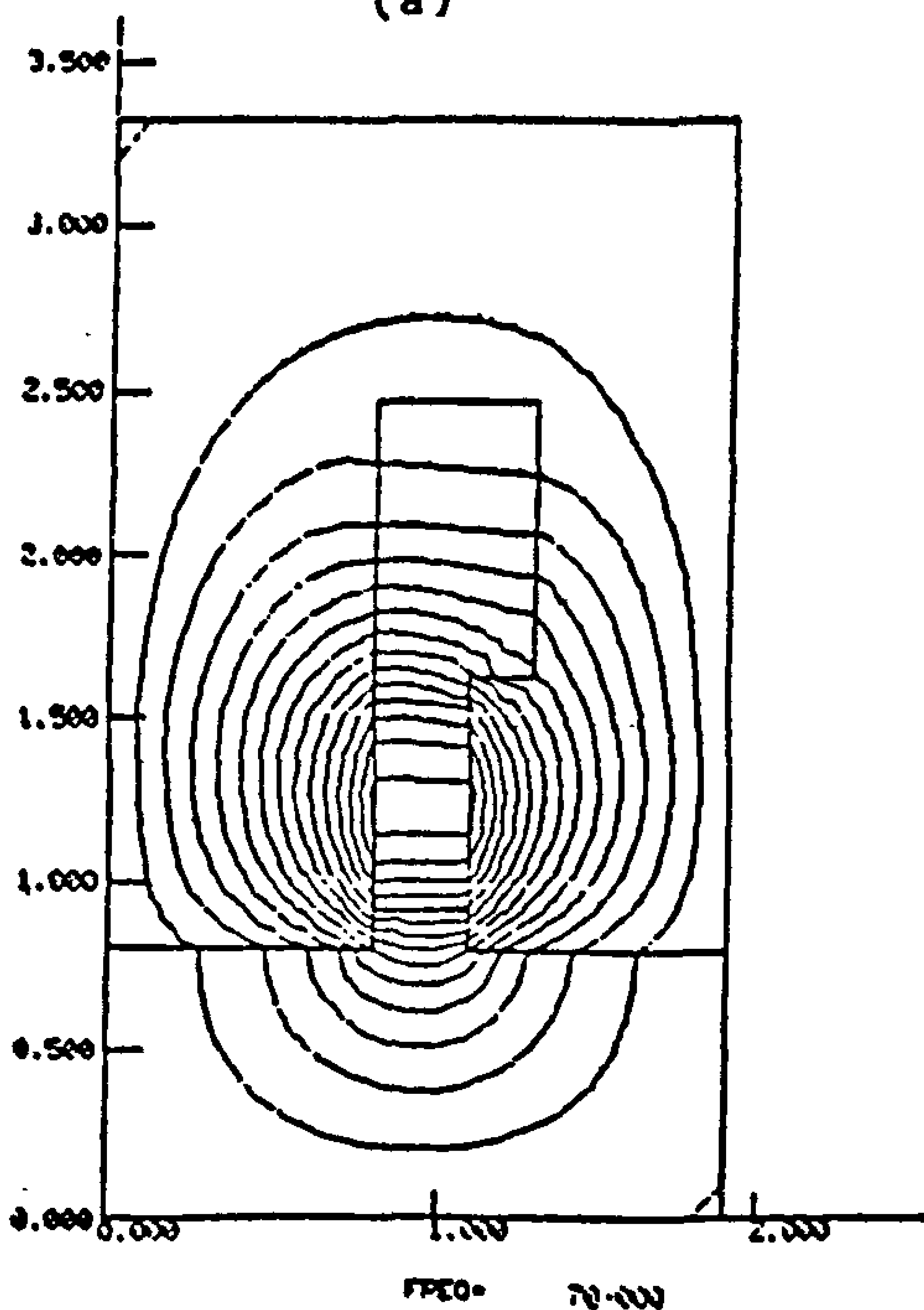
As is well known, the rotor circuit constants are strongly frequency dependent. Increasing the rotor frequency is seen to produce a reduction in slot leakage reactance and increase in the effective bar resistance due to skin effect. The flux distributions at different Frequencies for the L type rotor slot model are shown in Fig. (4) a-d.



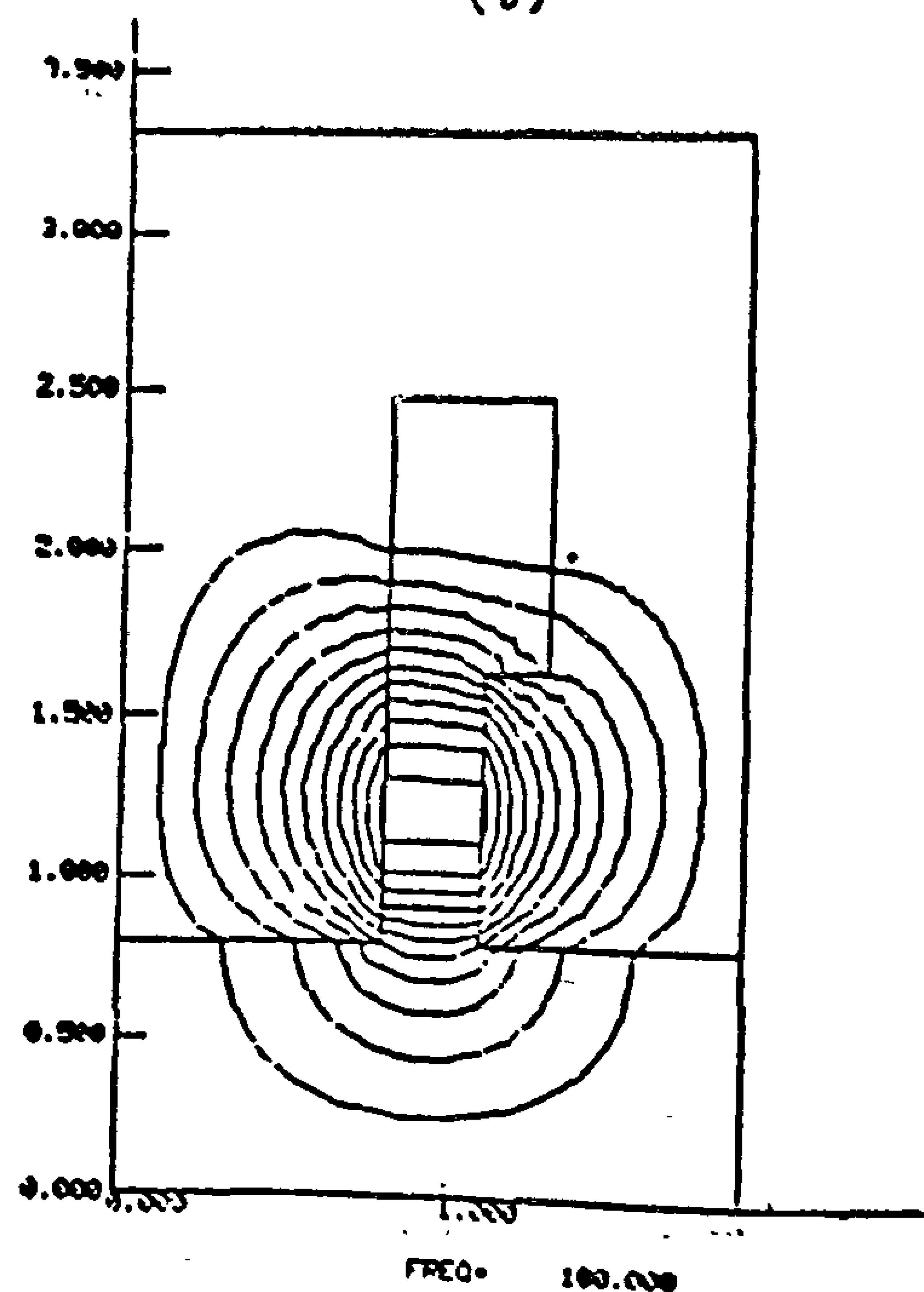
(a)



(b)



(c)



(d)

fig. 4 Flux distribution of the L type slot model for different frequencies, at 400 v. $\mu_r = 1137$.

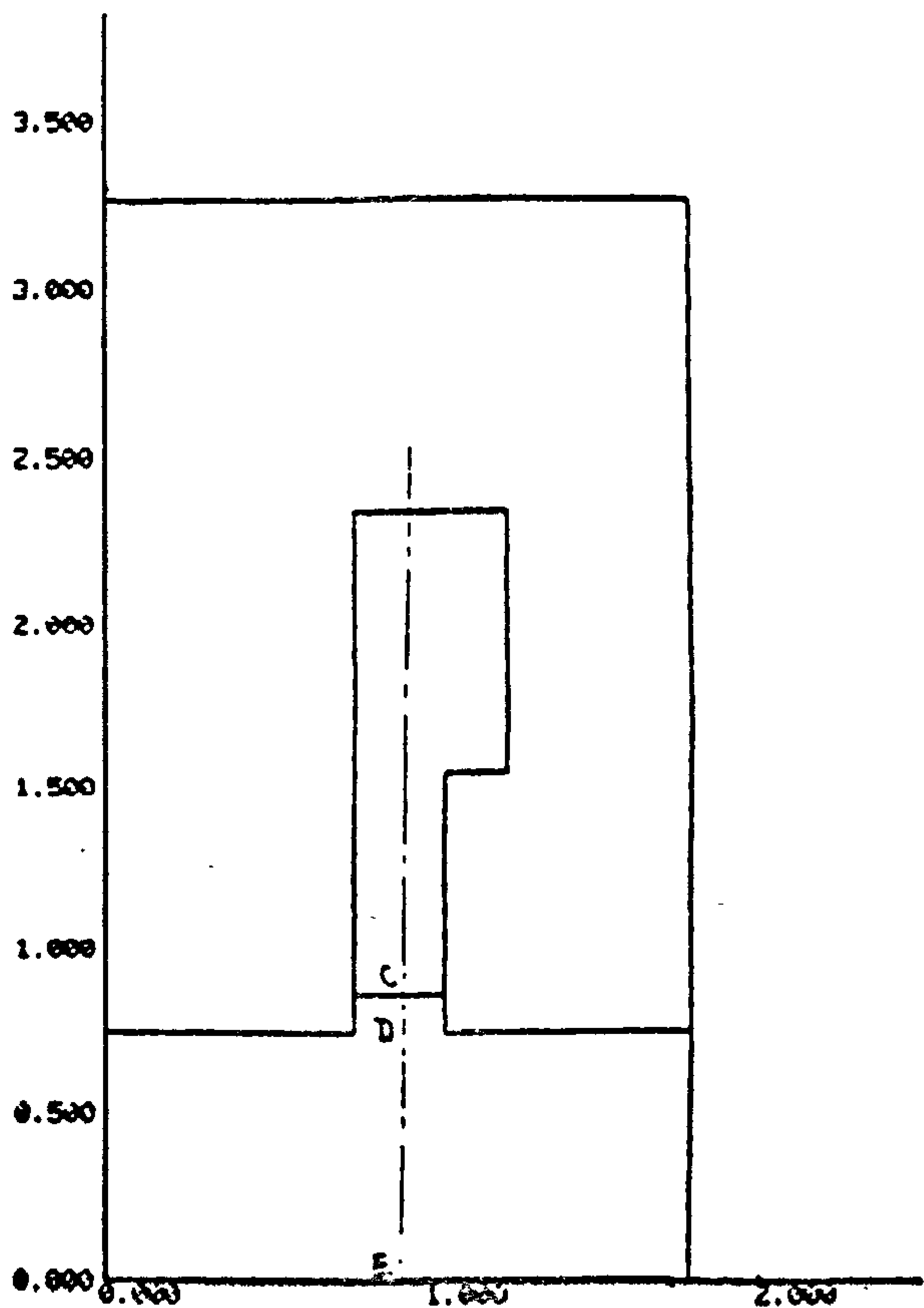


fig. 3 Analytical model

The a.c. resistance (R) and slot leakage reactance (X) of the bar are calculated as follows :

(a) Bar resistance :

Total real Power =

$$P_t = b_t\, d_b \sum_{i=1}^{i=top} \left[J_i^2 / \sigma \right] \qquad (7)$$

This must equal I^2R_{ac} from which

$$R_{ac} = P_t / I^2 \qquad (8)$$

For use equivalent circuit calculations, the bar resistance should be augmented by the effective end-ring resistance in the conventional way.

(b) Bar leakage reactance:

As in traditional flux leakage calculation methods it is convenient to partition the leakage flux into separate components as follows:

i-Slot leakage inductance : It may be evaluated by using equation (5).

ii- Slot tip leakage inductance: It is evaluated from the flux passes over the top of the bar, through the slot opening, i, e, that passes between C and D.

$$L_t = L_i \left[\mathrm{Real}\,(\underline{A}_c - \underline{A}_D) \right] / I \qquad (9)$$

iii- Airgap leakage inductance : It is determined from the flux that passes over the top of the slot, through the airgap, i.e. that passes between D and E.

$$L_g = L_i \left[\mathrm{Real}\,(\underline{A}_c - \underline{A}_g) \right] / I \qquad (10)$$

The bar leakage inductance also includes two components which are not derivable from the field plots. The largest of these is differential leakage inductance, the second component is the end-ring leakage reactance which is usually much smaller than the rest and is neglected. The variation of the computed value of the rotor resistance and reactance, at starting, with permeability of iron are listed on table (3).

Table (3)

Variation of the secondary circuit constants at starting, with the applied voltage (i.e with the permeability of iron)

Single cage model

Line voltage, v.	200	300	400	450	500
Relat. Permeability	3780	2971	1137	463	212
Total current, A.	83.33	99.11	139.85	162.18	183.04
Stored energy/ unit length $\times 10^{-4}$ Jou/cm	0.3926	0.4897	0.9737	1.303	1.653
Power/unit length, W/cm	0.0343	0.0495	0.0966	0.1263	0.1569
Slot leakage coefficient, λ_{ac}	3.176	3.168	3.164	3.150	3.138
A.c bar resistance, ohm $\times 10^{-4}$	2.52	2.52	2.469	2.40	2.341
Rotor leakage reactance, ohm	0.607	0.606	0.604	0.602	0.600
Rotor resistance, ohm	0.6156	0.6156	0.6057	0.5923	0.5809
$\lambda_{ac}/\lambda_{dc}$	0.9074	0.9051	0.9040	0.900	0.8965
R_{ac}/R_{dc}	2.745	2.745	2.689	2.614	2.550

netic energy stored in the slot and equating it to the energy stored in an equivalent inductance as follows :

$$L = \int_v \underline{J}.\underline{A}\, dv / I^2 \qquad (5)$$

Table (2) shows the computed values of the stator slot leakage reactance for different applied voltages. The ratio (x, /x), between the value of slot leakage reactance computed at a finite permeability of iron and at an infinite permeability of iron (assumed here μ = 4000) are also calculated. These results clearly indicate the influence of saturation on the stator slot leakage reactance. As expected, at high permeability of iron the leakage reactance is almost constant and the larger in comparison with the reactance at low permeability of iron.

Table (2)

Stator slot leakage reactance results

single cage slot model

line voltage V.	current density A/sq.cm	permeability (rela.)	energy stored x10 J/cm	slot leakage reactance ohm	$K=x/x_\infty$
200	27.38	3785	1.7843	1.0828 x	0.985
		4000	1.810	1.0984 x_∞	
300	41	2971	3.9632	1.07	0.974
		4000	4.0671	1.0984	
400	56	1137	6.9054	0.9959	0.906
		4000	7.616	1.0984	
450	63.88	463	8.1273	0.9059	0.825
		4000	0.854	1.0984	
500	72.36	312	9.6513	0.8384	0.763
		4000	12.643	1.0984	

5- Effect of iron permeability on the secondary circuit constants.

In this section, a finite element solution of the diffusion equation (1,5) is presented for the case of constant permeability of the magnetic parts. The magnetic field distribution in the model may be determined, if the potential is known at any instant and point of the cross section of the model. This is achieved by solving the diffusion equation :

$$\frac{\partial}{\partial x}\frac{1}{\mu}\frac{\partial A}{\partial x} + \frac{\partial}{\partial y}\frac{1}{\mu}\frac{\partial A}{\partial y} = j w \sigma \underline{A} - \underline{J} \qquad (6)$$

Where ($J\,w\,_\sigma A$) term is the induced current density, and σ is the material conductivity. Diffusion equation solutions are used to estimate the steady state flux distribution in the machine model. These internal flux distribution can be translated into terminal quantities-pertubution in voltages and currents, which one can use to derive equivalent circuit parameters and to predict the performance under different operating conditions.

This section presents a method of computing a magnetic field over a cross-section of rotor slot model, in which the slot leakage coefficient and effective resistance, which are slot constants, are calculated under different operating conditions.

The method described enables the rotor resistance and leakage reactance to be calculated as a function of permeability of iron and rotor frequency, for any shape of rotor bar.

Analytical model of cross-section of L type rotor slot only is used as shown in Fig. (3). In this model, the airgap is assumed to be infinitely wide and the total amount of current flowing in the rotor bar and the frequency of the current are given.

(a) the flux distribution in the motor determined by solving eq. (1) for any phase Current I_u.

(b) The flux linkage of the u phase windings is calculated as :

$$\psi_u = (A_{1m} - A_{2m}) N L_s P_i \qquad (2)$$

Where A_{1m} and A_{2m} are the arithmatic mean vector potential of the left and right coil side respectively.

(c) The induced phase voltage E_u is then written as :

$$E_u = -jW\psi_u \qquad (3)$$

Consequently, the magnetizing reactance can be calculated from :

$$X_m = E_u / I_u \qquad (4)$$

The summary of no-load results for different applied voltages, i.e. different Permeability of iron, is shown in table (1).

Table (1)

Summary of no-load finite element method results

Single cage model

ap.line voltage v.	mag. current A.	relative permeability	av.flux density Wb/sq.m	potential difference $x10^3$ Wb/m	induced e.m.f ph.v	mag. reactance ohm
200	5.207	3785	0.2349	1.94	112.00	21.51
300	7.65	2971	0.3452	2.91	164.55	21.50
400	10.58	1137	0.4594	3.892	219.00	20.70
450	12.20	463	0.5100	4.385	243.15	19.93
500	14.00	212	0.5623	4.873	268.10	19.15

As is to be expected, the value of magnetizing reactance varies with the drop of permeability of iron due to magnetic saturation of the main flux path. The effect of saturation is to limit the flux in the iron of the main flux path and this causes a reduction of the magnetizing reactance.

4- determination of stator slot leakage reactance.

In this section, the Gaussian quadrature method (3,4) is used to calculate the magnetic energy stored per unit length from product of current density and vector potential integrated over the area. The aim of this calculations is to determine the influence of the drop in the value of the permeability of iron due to saturation on stator leakage reactance.

At no-load, the resulting flux plot for stator and rotor slot model at 400 (V) is shown in Fig. (2).

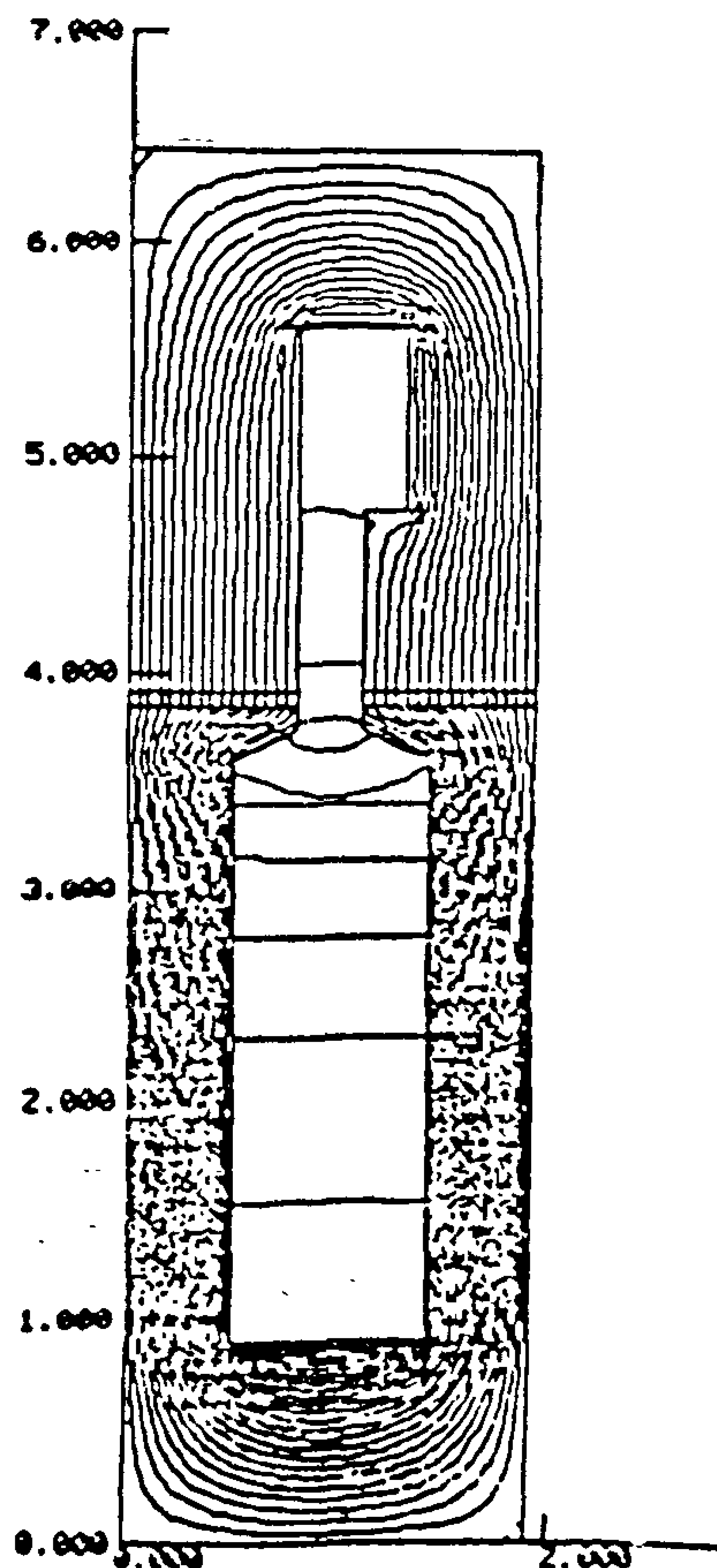


Fig. 2 No load flux for single cage slot model at different rotor positions, V = 400 v., μ = 1137

It can be seen that at no-load there is no rotor current and most of the airgap flux goes all the way down the rotor teeth, in perference to crossing the slots. Therefore it can be assumed that at no-load there is no rotor leakage flux, so the flux in the rotor iron is simply the mutual flux. The slot leakage inductance may be evaluated by calculating the mag-

(a) The motor is infinitely long and the magnetic vector potential has only a component along the axis of the machine.

(b) The iron parts are isotropic and B-H characteristics are single-valued.

(c) The Current density Vector J has a component only in the axial direction.

(d) The magnetic fields outside the machine contour is negligible therefore regions external to the stator are not considered.

(e) The positions of the stator and rotor are assumed to be fixed and the stator winding to have a balanced 3-phase configuration.

Generally speaking in the case of static elecro-magnetic field, the field variables are governed by the following elliptic partial differential equation.

$$\frac{\partial}{\partial x}\left(\frac{1}{\mu}\frac{\partial A}{\partial x}\right)+\frac{\partial}{\partial y}\left(\frac{1}{\mu}\frac{\partial A}{\partial y}\right)=-J \qquad (1)$$

Where A is the magnetic vector potential along the Z-direction. Equation (1) must satisfy the natural boundary conditions (5). The solution of eq. (1) gives the vector potential in cross-section of machine. Equation (1) is the nonlinear equivalent of the usual Poisson equation.

In 'PE2D' package, the Galerkin weighted residual procedure (10) is used for formulating the problem. Applying the Galerkin procedure over each element in turn yields a set linear simultaneous equations with a symmetric spare cofficient matrix, which is solved using a preconditioned conjugate gradient method. A First -order triangular element is used in the formulation presented in this paper giving constant flux density and permeability in each element.

The flux distribution patterns are of great use in obtaining an understanding of operation of the machine and in identifying the areas where the iron is underfluxed or overfluxed. The no-load flux plot for single-cage model is shown in Fig.(1)

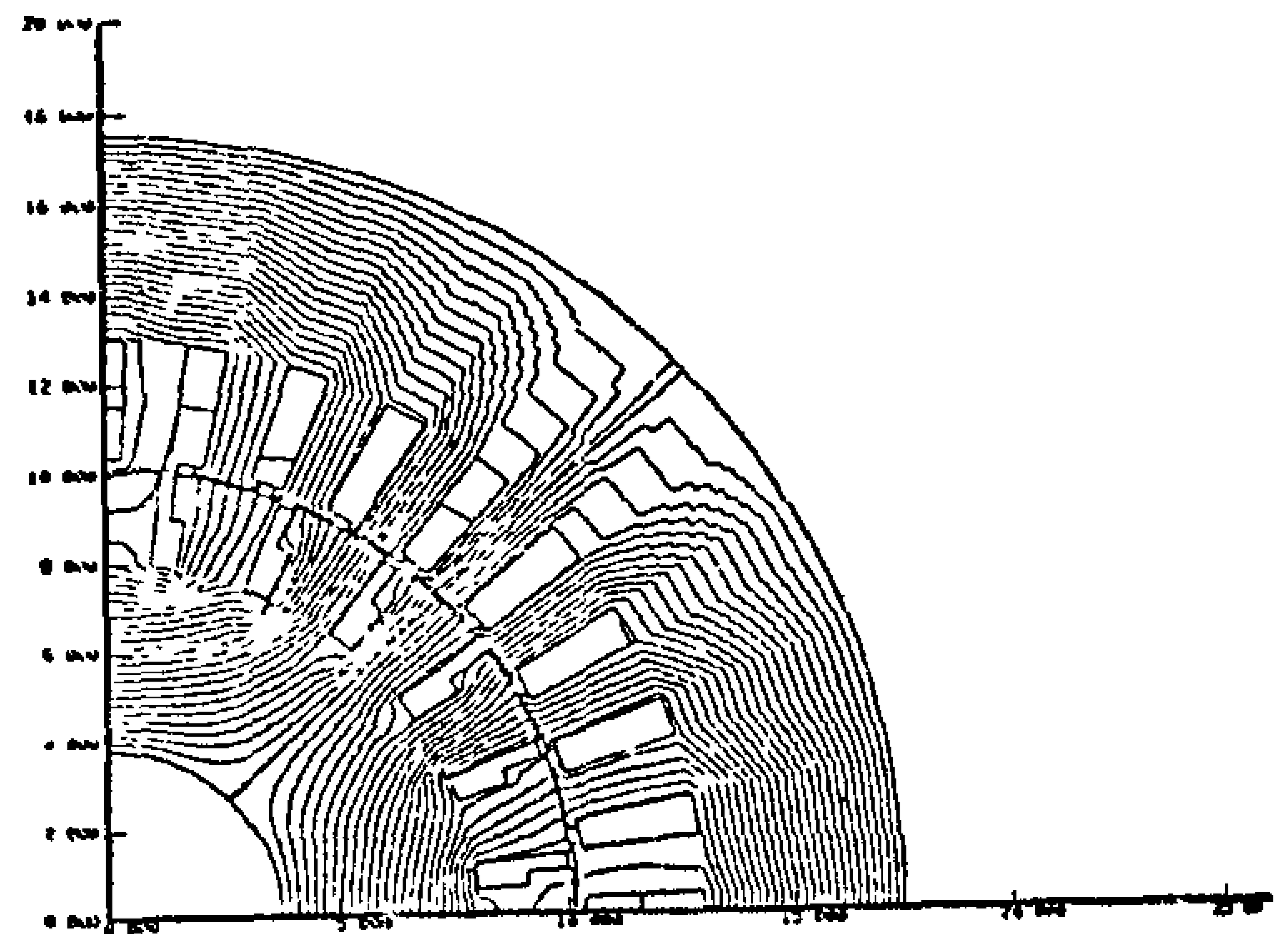


fig. (1) No-load flux plot for single cage model at 400 v. $\mu_r = 1137$

In order to determine the airgap flux density and its harmonic components, the procedure developed by Williamson (6) is used.

The harmonic of airgap flux density may be obtained by invoking Fourier analysis through a numerical integration procedure. From the above flux density distribution harmonic analysis one can predict cross over point between the actual arigap flux density and its equivalent sine distribution, which is dependent on the iron permeability distribution. In the following sections, the analysis of machine characteristic on the basis of its parameters defined from the permeability determined by the cross over points is presented.

3-...Determination of the magnetizing reactance.

This section details the use of computerized magnetic field solution, based on magnetic vector potential to develop a simplified approach to the calculation of the values of magnetizing reactance under various operating conditions.

The evaluation steps are summarised as follows :

SOME OF THE EFFECTS OF THE PERMEABILITY DISTRIBUTION ON INDUCTION MOTOR PERFORMANCE.

Dr. H.E. EL-DEEB* AND Dr. I.A.M. AMIN*

Abstract :

The paper describes a technique for analysing magnetic fields and determining the effects of permeability distribution on the performance of the 3-phase squirrel cage induction motor under different operating conditions. The method is based on the use of a finite-element field calculation which enables the precise machine geomatry to be modelled accurately, and includes the effects of saturation. A solution illustrating the effects of limited values of permeability distribution on the parameters of the equivalent circuit, and also the amplitude distribution of the space harmonics induced by the slot is presented. The results obtained with this method of analysis agree with the experimental results.

1. Introduction.

Three phase squirrel cage induction motors are widely used for various industrial applications. However, their design parameters are evaluated from the formulae based on the approximation to actual flux distribution in the machine cross section. In the past, approximate methods have sufficed. However, at the present time there is a greater need to build more efficient machines and to utilize material more economically.

In recent years, the finite elements method has become a very popular and practical tool for computing magnetic fields in electrical machines (1-10).

On single cage machines the present work is concerned with the use of the finite element to study effects of the saturation on the circuit constants of motors with current displacement rotors. The drop in the value of the permeability of iron due to saturation will introduce significant changes in the flux density distribution resulting in (i) different circuit constants for the secondary at starting and at running and also at different levels of voltages.

The objectives of this work are to assess these variations as accurately as possible to search (a) for an improved method of predicting performance characteristics and (b) for a synthesis technique to achieve an optimum design from a given requirement. Saturable magnetizing stator leakage reactance and rotor circuit constants are calculated and used in the equivalent circuit to determine the performance characteristics.

The results obtained using the method developed in this paper show excellent corretation with test results.

2. Formulation and solution of problems

In the following, the essential steps in the formulation of the problem will be outlined, and subsequently the steps required for solution will be shown in order to permit the induction motor problem to be approached in a practical way, the following assumptions are made :

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Appendix

The motor used to obtain the experimental results was a 2.4-hp. 220 V. 1500 r/min 4-pole slip-ring induction motor with the following parameters:

$R_1 = 2.29\ \Omega$

R_2 (referred to the primary) $= 3.67\ \Omega$

$X_1 = 5.395\ \Omega$

X_2 (referred to the primary) $= 5.72\ \Omega$

$R_m = 609\ \Omega$

$X_m = 75\ \Omega$

Chopper Parameter Values

Equations used here, for finding suitable values of the commutating inductor as well as commutating capacetor, are considered in Jones chopper circuit (6).

$$C \geqslant \frac{\pi\ I\ t_{OFF}}{2V_d}$$

$$t_{ON}^2 = \pi^2 L_c\ C$$

By considering $I = 3$ A, $V_d = 75$ V, $f = 500$ Hz $t_{OFF} = 1.3$ m sec.,

It is found that $C = 82\ \mu F$ and $L_c = 0.609$ mH

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6. S.A. Nassar, «Electric machines and transformers», New York, Macmillan Publishing Company, 1984.

pulse with duration about 400 us is connected to pin 6 of the 556 timer. This which is connected to act as a monostable multivibrator, serves two purposes : a) It reverses the signal to be positive and coinside with the beginning of the corresponding waveform generator pulse; b) Intermet every pulse to a number of pulses depending upon the values of RC components connected to this timer chip. In this application, connection was made to transform every pulse to three figure (5) pulses are more efficient to trigger thyris- This is because short successive duration are more effecient to trigger thyristors tors especially for inductive loads. The pulse transformers should be driven through a circuit having high input impedance. Therefore, two BD131 transistors (T2 and T3) in darlington configuration are used as shown in figure (4). Darlington circuit provides suitable current to drive puls transformers. Diode «D» is used to absorb any misfired signal in the diode transformer loop.

This driver circuit description was for the main thyristor. The same manipulations are occured for the ouxiliary (commutating) thyristor. The waveform generator output is inverted, using 7404 chip, as shown in figure (5) (pulse labeled"A"). The inverter output follows the same steps as before.

Practical Results

Samples of practical results taken in the laboratory are drawn in figure (6) Torgue/speed (T/N) curves at different motor loads are given. These results were obtained by varying the duty cycle of the choppercircuit using RA and RB of figure (4). As the ON time increases, the euivalent resistance of R1 and R2, figure (3) decreases, and hence the motor speed increases.

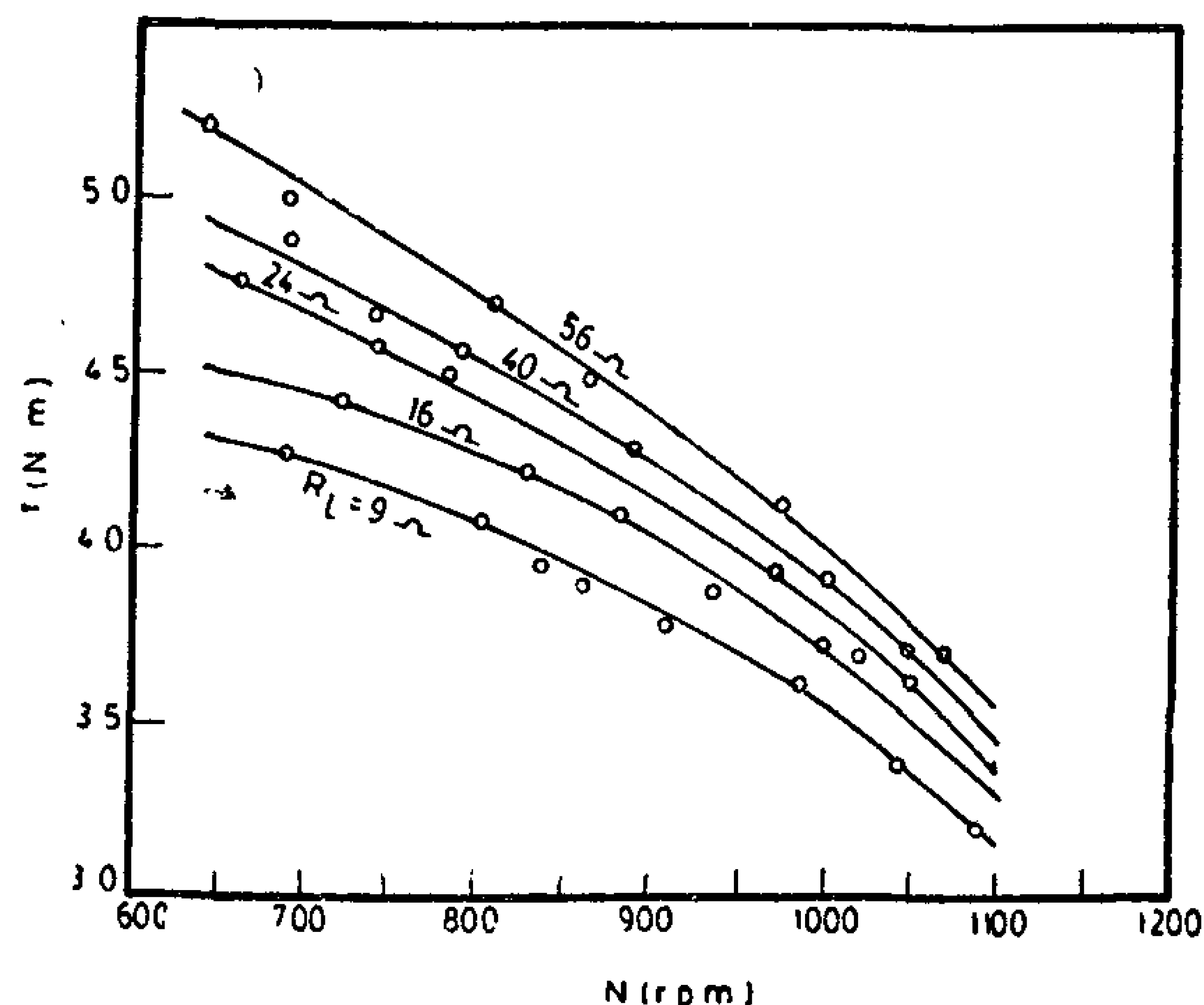


Fig. 6.

At low torque values the current fails to commutate the main thyristor. For this reason, the low torque values had not at no load for the same reason. The results been reached. Also the commulation fails were taken in the stable region of T/N curves of the induction motor. The available resistive load, in the laboratory, did not permit to raise the totque (or load current) more than the values shown in the curves. Off course as RL increases, torques at similar speeds also increase.

Conclusions

A speed control system for driving slipring induction motor using thyristor chopper has been described. The system is entirely digital except for the motor side itself. A novel digital firing circuit has been designed and thyristor firing signal at each stage is given. The design of the chopper used in this system is simple and reliable. Pulse transformers are used for isolating the signal circuits from the power circuits. Torgue speed curves are also presented for different loads.

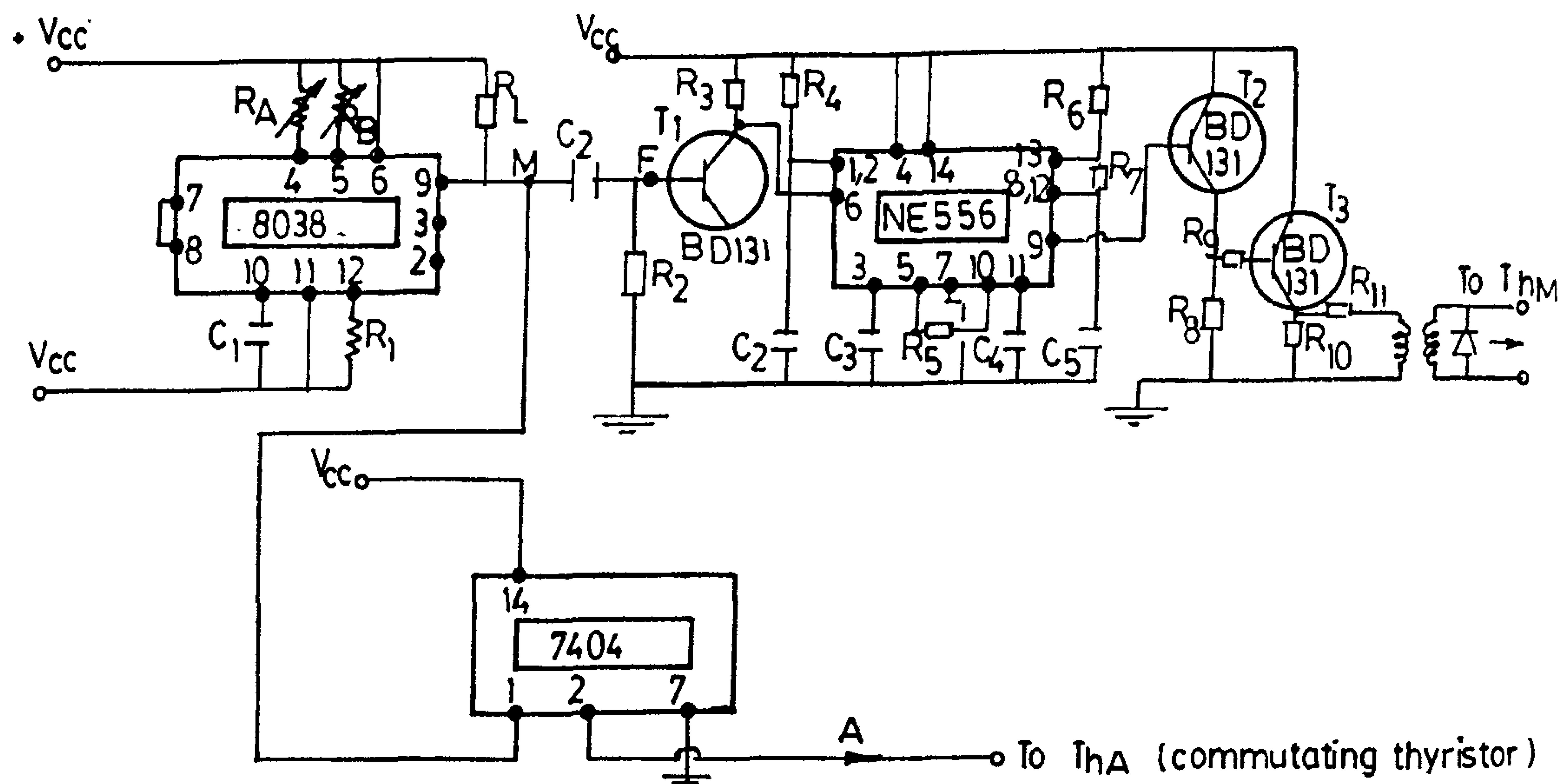


Figure 4 . Detailed firing circuit .

The IC 8038 waxeform generator, of low distortion and variable duty cycle (2% to 98%), is properly connected(4). This wide frequency range (0.001 Hz to 1000 KHz) waveform generator is used to produce a square waveform of high accuracy. By proper values of RA,RB andC1, the required frequency can be produced. A 50% duty cycle is achieved when RA equals RB. The output of the 8038 at M, M wave at figure (5), is the main signals for triggering the main and auxiliary thyristors. Between waveform output firing signals and driving stages, some manipulation for the signals are essential to be suitable for triggering thyristors. Two popular methods can be used to isolate between the firing circuit (logic side) and the thyristor controlled motor drive (power side): a) opto-isolators, or b) pulse transformers. The pulse transforformers can isolate a potential voltage up to 4KV(5). For this reason and their easier instullation, pulse transformers are adopted in this work. Firing circuit description will be given in the following section:

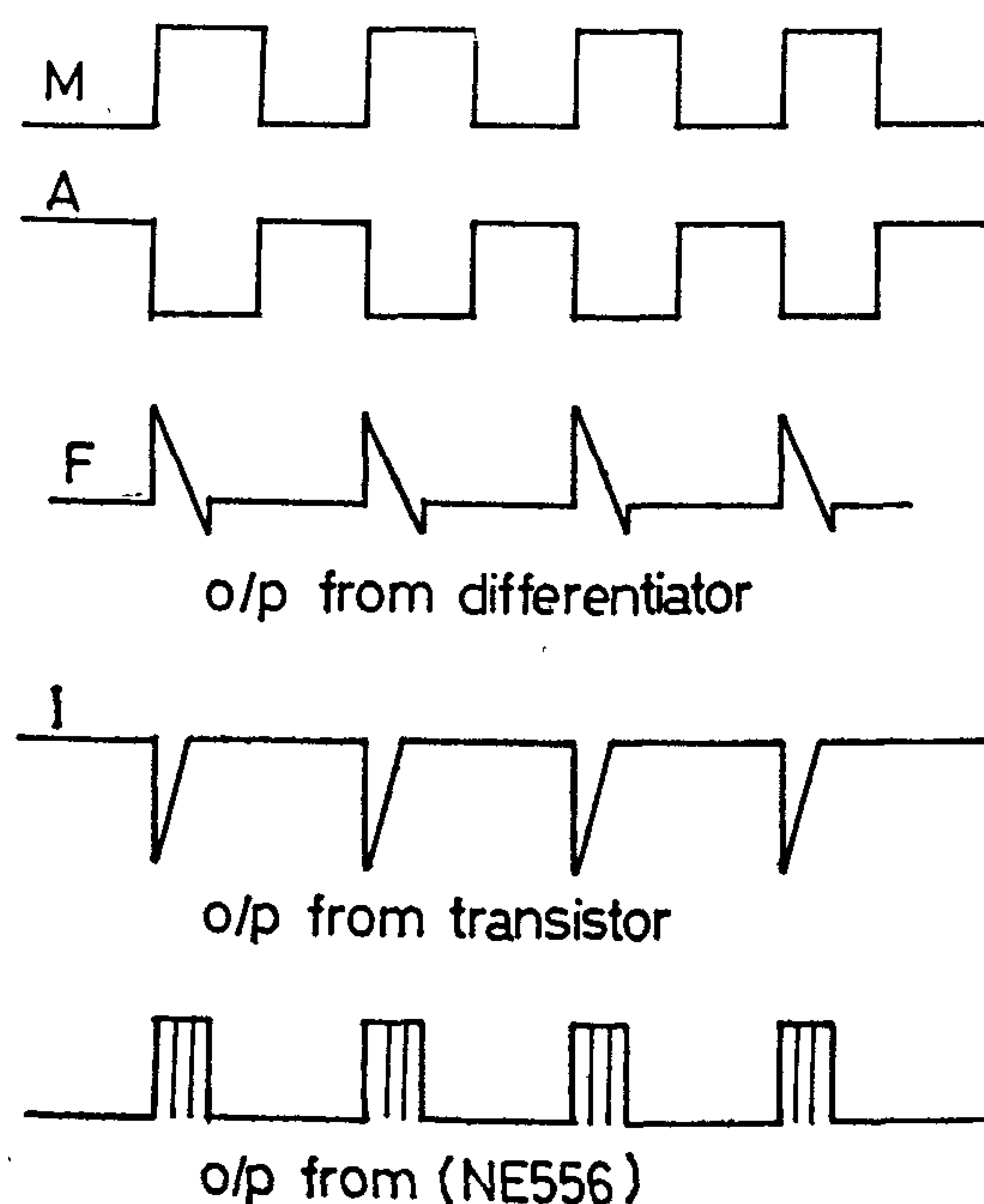


Figure 5 Firing signal manipulations

Waveform generator output pulse is differentiated by R2 C2 circuit. The differentiated output is labeled «F» in Fig. (5). This output is fed to the base of high gain, BC547, transistor, T1. This transistor amplifies and reverses the differentiated pulses. Its output pulse is labeled «I». This

tio») is controllable. Thyristor characteristics limit the chopping frequency. Turn ON-to-OFF or «mark/space ratio») is controllable. Thyristor characteristics limit the chopping frequency. Turn ON is straightforward, but turn OFF requires forced commutation. Capacitor, C, is called commutating capacitor, while inductor, Lc, is called commutating inductor. ThA is an auxliary thyristor connected in parallel with the main thyristor to commutate its current. By regulating the chopper periodically so that in each periodic time, ThM is ON for some time and OFF for the rest, it is possible to obtain a variable equivalent resistance from R1 to (R1+R2). Consequently, this chopper circuit electronically varies the external resistance, R2, in a continuous and contactless manner. The commutating capacitor must be large enough to maintain the discharge current for a time longer than its turn-OFF time. Detailed design of the commutating circuit is given in the appendix. Explanation of the circuit operation is given. below:

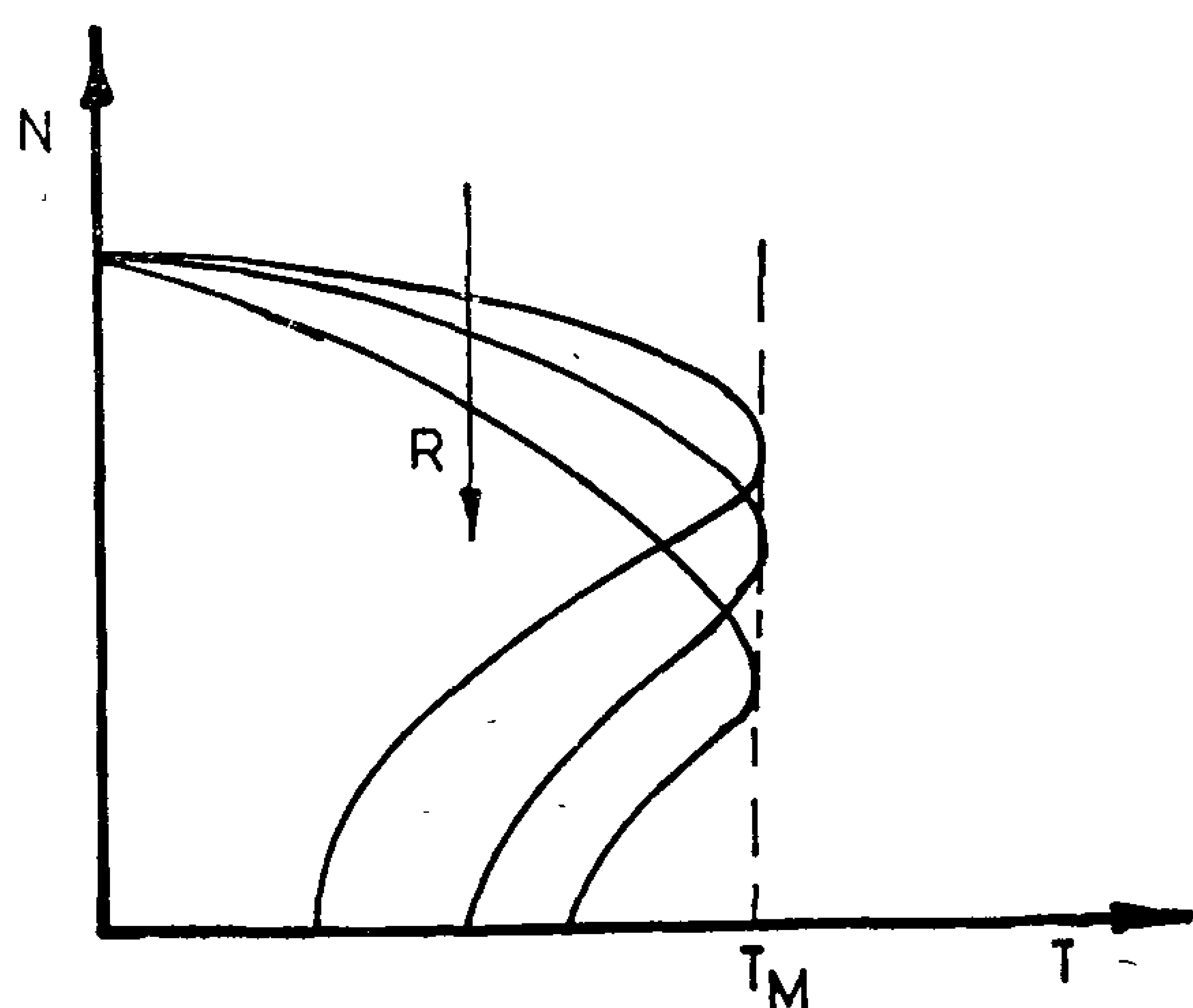


Figure 1 : T/N characteristics for rotor resistance control

Th_A is fired to charge the commutating capacitor to a potential difference, Vd, with the upper plate positive. When charging is complete, the current ceases and

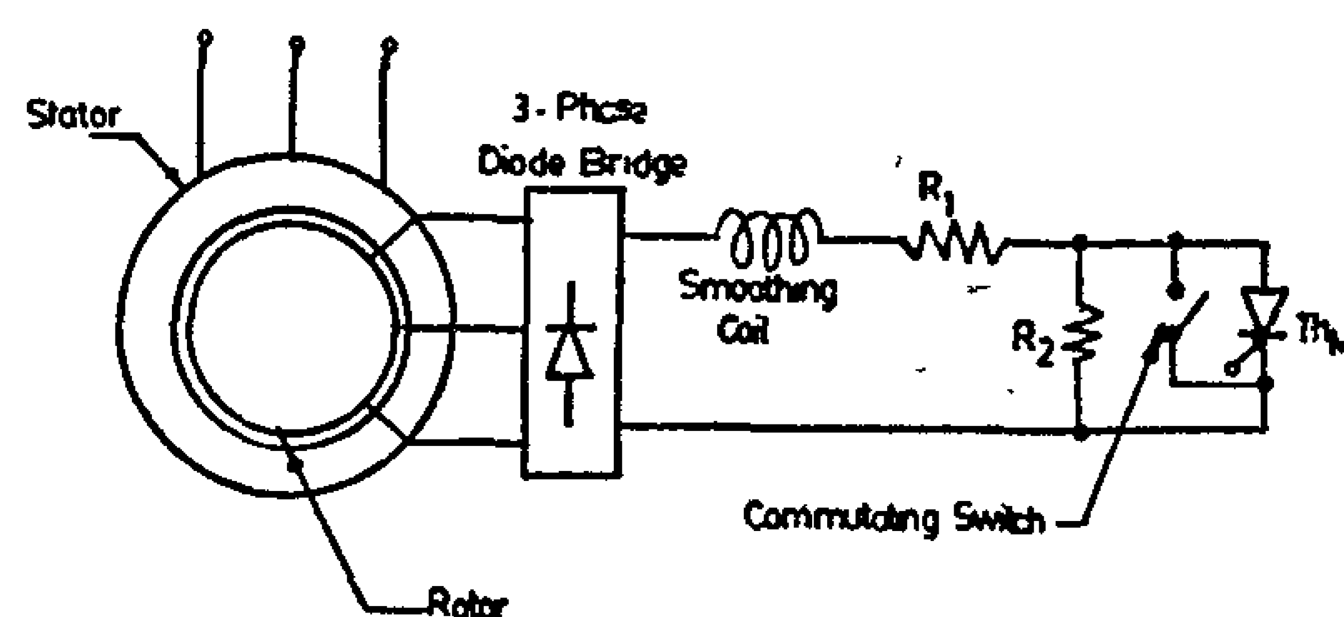


Figure 2 Basic chopper circuit

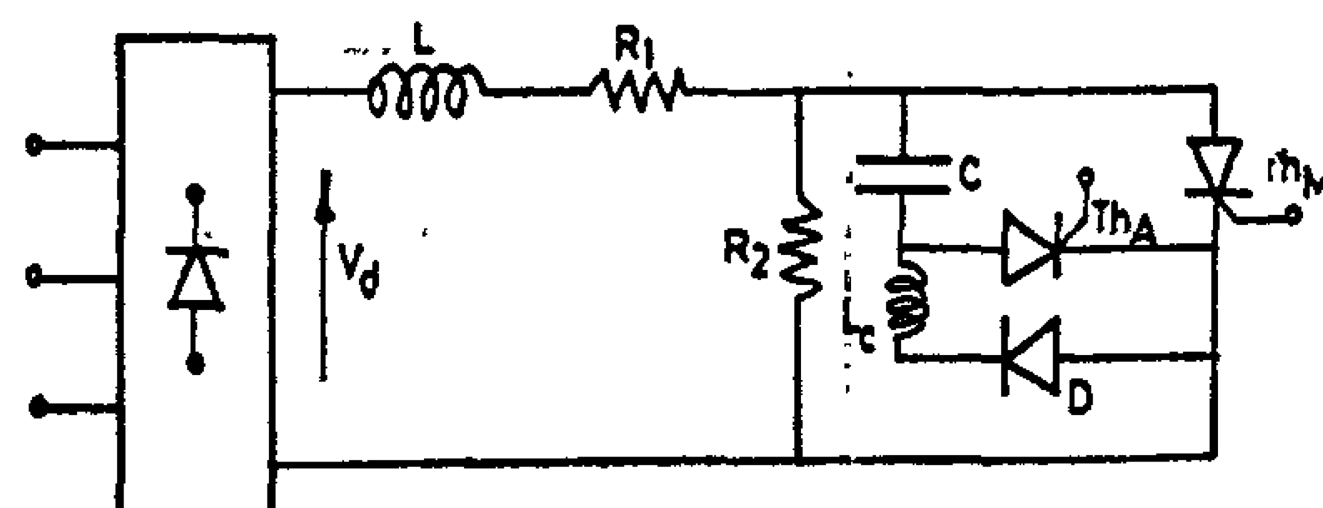


Figure 3. Chopper circuit.

Th_A turns-OFF naturally. To start the ON period, ThM is fired. The current begins to pass through R1 and simultaneously C discharges rapidly through ThM, diode D and inductor Lc. This is by means of an inerentntly oscillatory current of angular frequency $w=\frac{1}{\sqrt{LC}}$. The first half cycle can only flow because of the blocking property of diode. Thus C is isolated with a potential difference of -Vd. The lower plate of C is now at a potential + 2Vd, and this condition exists throughout the duration of the ON period. To quench the main thyristor current, ThA is triggered to reverse bias ThM, and, C discharges. When ThM completes its turn-OFF, C is recharged to its original polarity to start the next ON period. Firing Circuit.

Firing Circuit

Firing circuit design with its reliable operation is the most important section in the controllers of electric drives Detailed driving circuit of the main thyristor figure (3) is shown in figure (4).

NOVEL DIGITAL FIRING CIRCUIT FOR A CHOPPER CONTROLLED SLIP-RING INDUCTION MOTOR

M.A. Zaher*

M. El-Sheikh Mahmoud**

ABSTRACT

Speed control of a slip-ring induction motor drive is carried out by using a thyristor-controlled chopper circuit on the rotor side. A detaild design, and realization, of novel digital firing circuit is presented. The chopper and its commutating circuit are, also, designed and built. Interfacing between the chopper side and firing circuit side are made using pulse transformers. Experimental results were taken and speed-troque characteristics, at different loads, are given.

Introduction

Conventionally, speed regulation of the slip-ring induction motors can be fulfilled using three phase rotor resistance. This resistance is controlled manually and in discrete steps. Figure (1) shows the speed-torque characteristics for different values of rotor resistances. The advent of power semiconductors continues the trend toward digital thyristor, or power transistor, control in industrial applications.

The conventional resistance control can be eliminated by rectifying the slip-ring output voltage and then feeding it to a chopper-controlled external resistance as shown in figure (2) (1). The speed control is electronically fulfilled by the ratio of ON-to-OFF time of the main thyristor, Th_m. is used to vary the equivalent resistanre in the rotor circuit. By operating the chopper in the ON mode all the time, the equvalent resistance will be R_1' When the chopper in the OFF mode all the time, the equivalent external resistance will be (R_1+R_2) Thus, the equivalent resistance can be varied, electronically, between R_1 and (R_1+R_2) by regulating the chopper period so that it is ON for some time and OFF for the rest. The duty cycle of the chopper tON/(tON + tOFF), is controlled by a puls width modulation method (constant frequency, variable pulse width).

This arrangement for controllng the external resistance, and consequently controlling the average value of the rotor current, may produce voltage spikes across the chopper thyristors and discontinuity in the rotor winding currents. These problems could be coped by building either first order or second order fiilter with the chopper circuit. The design criteria for these filter are given in Ramamoorty and Wani(2). and Sen and Ma(3).

Power Circuit Description :

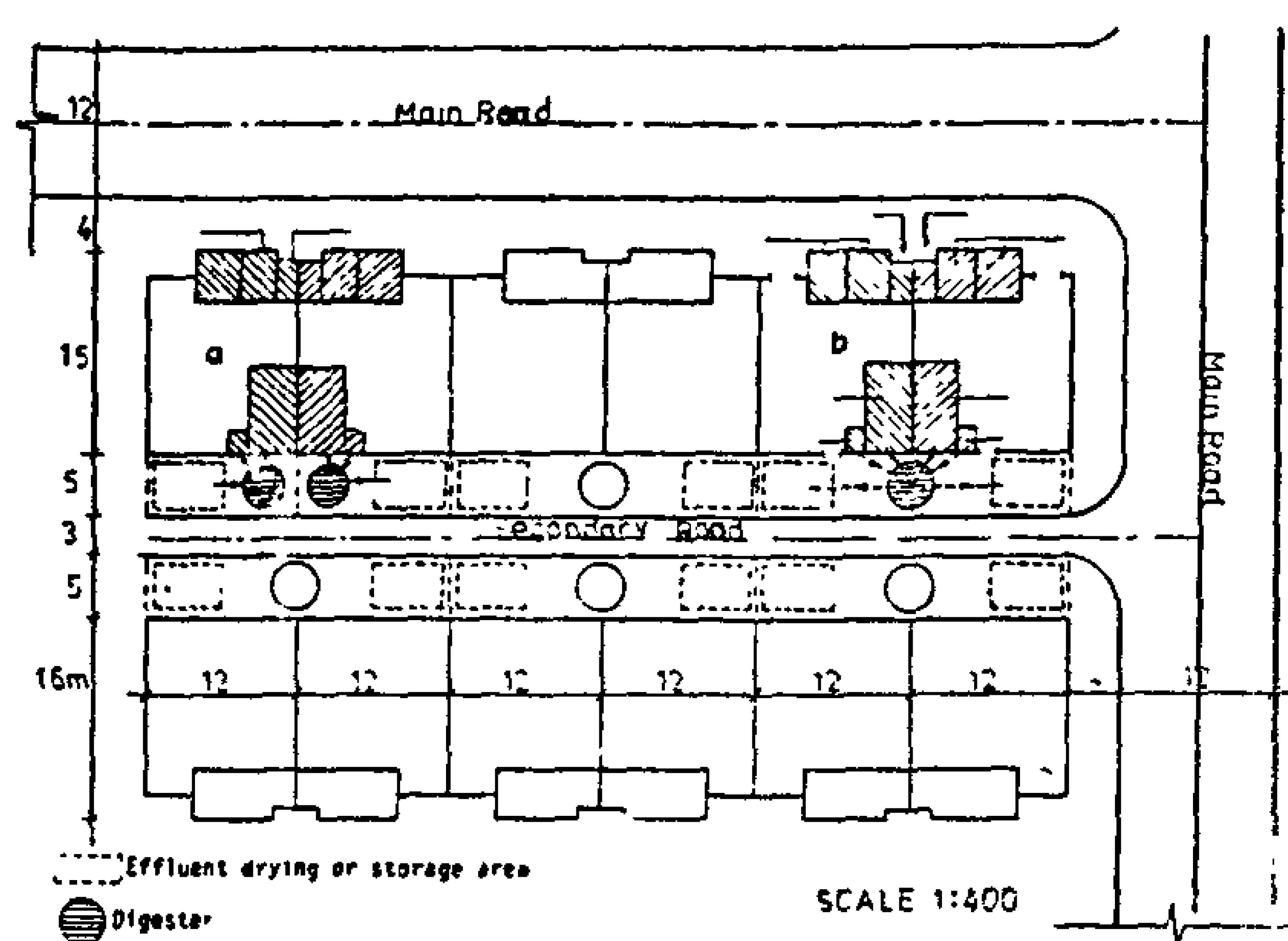
Figure (3) shows the chopper circuit used for controlling the motor speed at load operation. This circuit produces fixed frequency, PWM, output. The duty cycle (ratio of ON-to-OFF or «mark/space ra-

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a) Family type b) small communal (2 Families)

Fig. (5) Layout of Biogas Systems

LARGE BIOGAS STSTEMS

Free areas are left on the boarder of the village for construction of large biogas systems. The large biogas units are operated using the organic wastes of the large animal sheds, poultry farms, and dry agricultural wastes (crop residues).

5.3. DEGREE OF SELF SUFFICIENCY IN ENERGY BASED ON BIOGAS

The energy required for cooking and heating can be obtained from the family or small communal units, with self sufficiency reaching about 100% for household needs. The electrical power can be produced from the large units. Based on the data available from a typical village, more than 800 m^3 gas can be produced daily using the animal wastes (400 large animals) and only 60% of the crop residue available (540 tons crop residues/year). The gas produced can partially be used to supply the adminstrators houses with household needs, while the main art is used for producing electrical energy required for illumination and operation of small rural industries. More than 2 kWh can be supplied daily to every family. Thus, the village can be self sufficient in energy depending on biogas.

The total amount of gas produced is appreciable as shown by the following:

- Biogas produced from family and communal units = 300x1.5 = 450 m^3/day.
- Biogas produced from large animal sheds = 400 m^3/day.
- Biogas produced from fermentation of crop residues = 400 m^3/day.

Total biogas produced= 1250 m^3/day.
Equivalent to 750 L. Kerosine/day.
Equivalent to 270 000 L. Kerosine/year.

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2. M.A. Hamad, A.M. Abdel Dayem, M.M. El Halwagi, «Performance Evaluation of two Rural Biogas Units of the Indian and Chinese Versions» J. Energy in Agriculture 1,235 (1983).

A road, with at least 3 m width, is necessary to be extended through the backyard area. The road facilltates reaching the digester for maintenance purposes, besides it can be used in transporting the liquid or dry fertilizer to the fields. The animals can also use the road as a main access for getting in or out of the shed, instead of using the front entrance and reach the shed through the house. This helps keeping the house clean and tidy, and improving the health conditions inside the house.

The new proposed plan for the village previous suitable areas for constructing the large digesters, neccessary, together with the family and communal types, in supplying the village with the required energy. These areas are located at the edges around the village to achieve the required health conditions and to ease the handling and the transportation to and from the fields. The chosen areas for the large digesters are illustrated in Fig. (4). by dotted lines.

5. APPLICATION OF BGT BASED ON THE PROPOSED MODEL

To illustrate the importance of utilization of the proposed model for the new constructed villages, the expected impact of BGT as fuel is estimated here based on utilization of the dry and wet wastes of the planned village.

5.1. The Specification of the Village and the Expected Amounts of Wastes

For evaluation of the produced organic wastes some parameters are assumed to prevail under the Egyptian conditions. These are:

- Number of farmer houses = 300 house (family).
- Number of houses of adminstrators and supervisors = 24 house (family).
- Average number of persons in the family = 5 persons.
- Average land holding = 5 acres/family.
- Total cultivated area of the village = 5x300 = 1500 acres.
- Average animal ownership = 5 large animals/family.
- Number of animals in the large animal sheds = 400 large animals.
- Amount of agricultural residues (crops) available for fermentation = 0.6 ton/acre-year = 900 tons/village year.

5.2. PROPOSED BIOGAS SYSTEMS

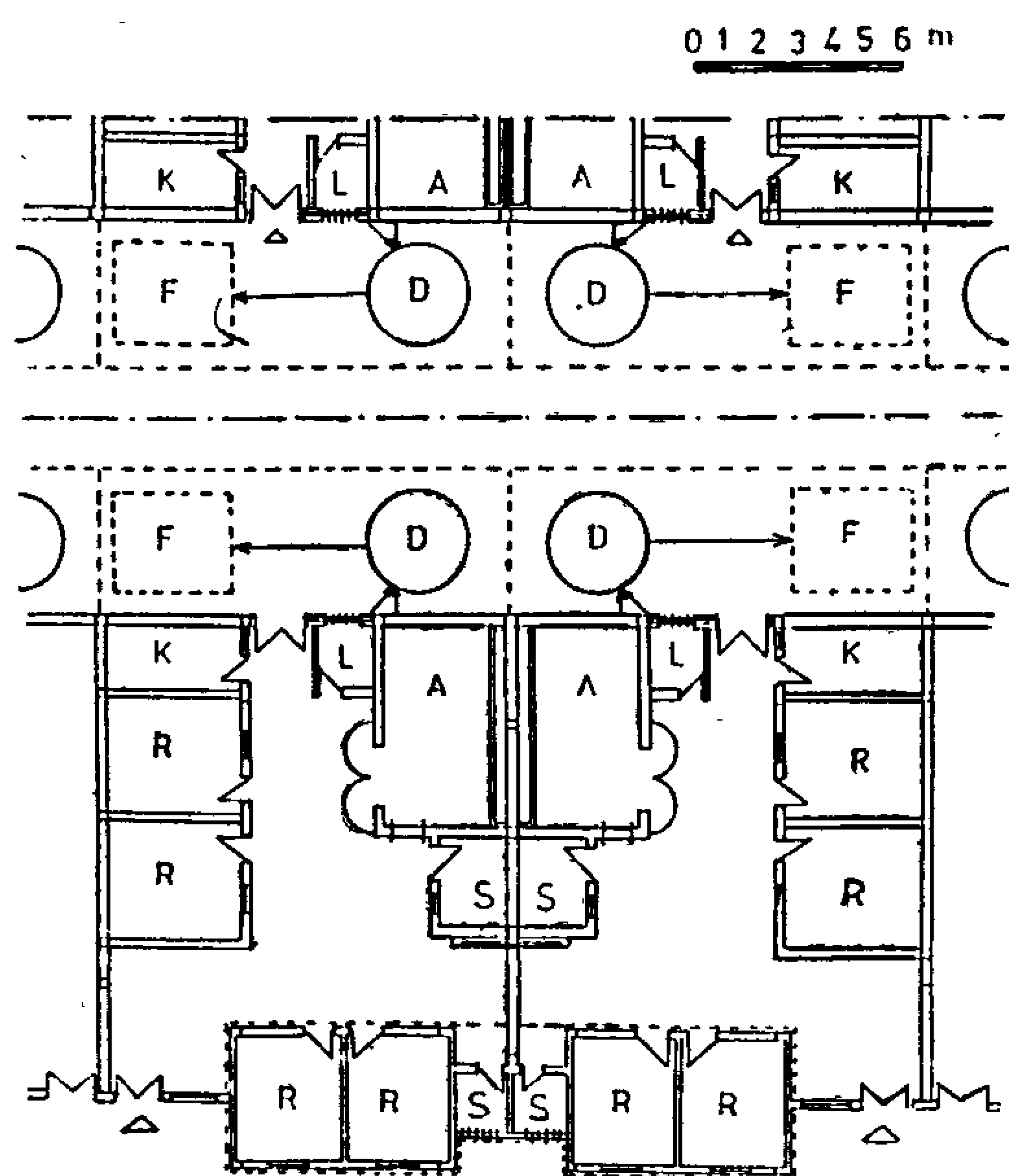
The proposed planning model incorporates the application of different biogas systems (family, communal, and large units) in an integrated sequence to attain the self-sufficiency in energy depending on biogas:

FAMILY-TYPE BIOGAS SYSTEMS

The new plan of village allows construction of family units in all houses. Fig. (5-a) shows the layout of the family units. Cost of connections are minimized. The effluent is either dried or stored in liquid phase and used as organic fertilizer. Based on the availability of 5 animals, the unit can produce about 1.5 m^3 biogas/day (2) which is equivalent to about 30 L kerosine/month and is sufficient to cover the family requirement.

COMMUNAL TYPE BIOGAS SYSTEMS

To reduce the cost of the family units, communal units can be constructed for two families or more as shown in Fig. (5-b). The proposed location of the animal sheds and laterines leads to accomplishing the connections at minimum cost,



K-Kitchen L-Latrine A-Animal Shed S-Stors D-Digster F-Fertilizer Drying Area R-Room.

Fig. (2) The proposed modified house model for model 81/A.

4. THE PROPOSED VILLAGE PLAN

Fig. (3) shows a plan for one of the modern villages which has been constructed in the new desert communities. The plan illustrates a typical design for planning a new village in Egypt.

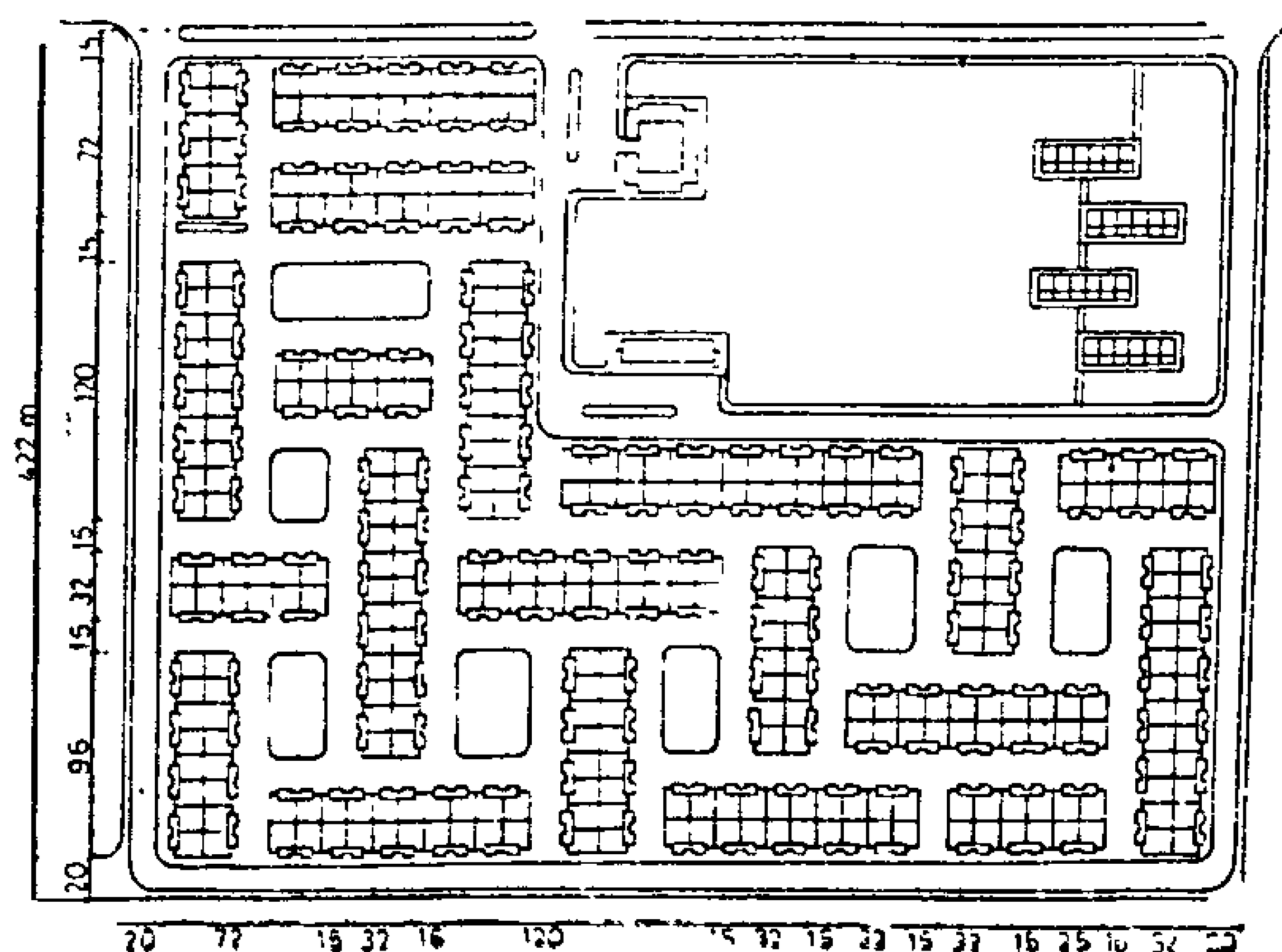
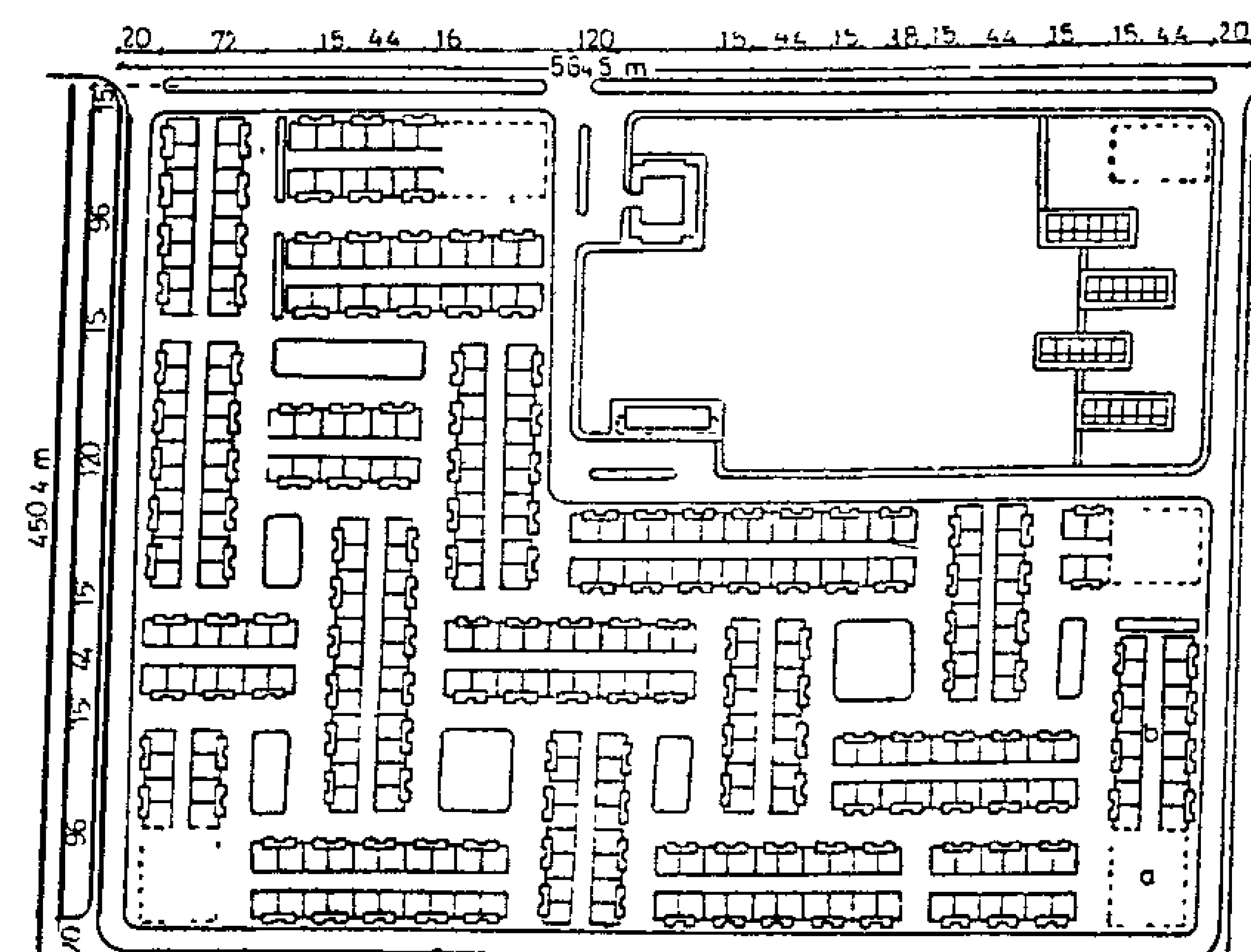


Fig. (3) The village plan used in new reclaimed desert areas

The houses of the village are arranged side by side in rows. Each row of houses is back to back with the other and every two rows are separated by a main road. In this design, no free spaces are left to allow constructing the biogas systems. For this reason, a new proposed plan for the village is shown in Fig. (4). A longitudinal area has been added between each two adjacent rows of houses to be as a free backyard and a secondary road. This area has to be wide enough for constructing the biogas system behind each house and close enough to the latrine and the animal shed.



(a) Free area for large digester.

(b) Back yard area.

Fig. (4) The modified village plan.

A family-size digester is usually2-3 m in diameter and can be used for one family or shared between two houses. In addition, 1 m free space has to be left all around the digester. Thus, a 5 m space is the width of the whole area which is required behind each row of houses in the village. This area can also be used for drying or storing the organic fertilizer which is regulary produced from the digesters.

In the design of the house, the latrine has to be located closer to the animal shed and adjacent to the free area available for digester erection in order to facilitate connecting both of them to the digester at the minimum possible cost.

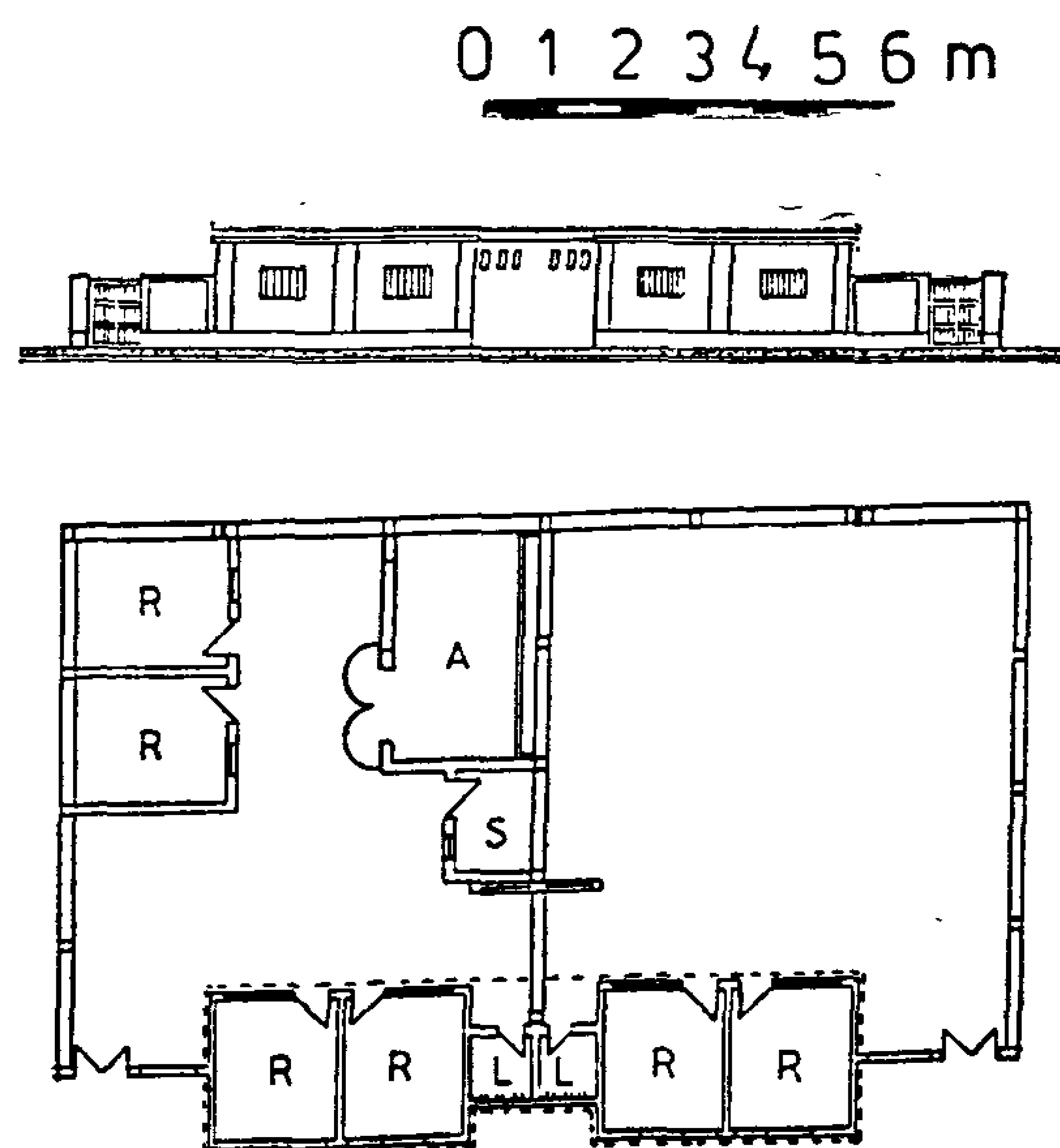
Meanwhile, when planning the village, enough space has to be left between the houses to allow for construction of the family-type biogas units. This space will also be needed to facilitate the handling and transportation of the effluent organic fertilizer. In addition, areas have to be cleared at different spots all round the village to construct some community and large digesters. These digesters can be fed by organic wastes produced from large animal sheds and crop residues.

The family-type digesters are able to produce the required household energy for the rural families. On the other hand, the village can depend on the large digesters to obtain its need from the electrical energy to illuminate the houses and roads, and to operate some small rural industries.

It is further recommended that each family in the village has to own about 5 acres of cultivated land and 5 large animals in order to have a quantity of organic wastes enough to operate the digesters and produce sufficient amount of biogas.

3. MODIFICATION OF THE FARMER'S HOUSE

Fig. (1) shows a plan for a common farmer house (Model 81/A) which has been constructed in one of the new reclaimed desert communities. This design belongs to the Organisation of the Constructions Projects and Agricultural Development. Each house contains two rooms, a latrine and a backyard with around 200 m total area. The house is not supplied with electricity, water or any wastewater drainage system. Moreover, the ability to increase the number of the rooms to reach four besides a kitchen and an animal shed is taken into consideration. This type of house is not suitable to the application of the BGT. The proposed modified plan for Model 81/A is shown in Fig. (2). In this model the latrine is moved close to the animal shed at the back side of the house and adjacent to the nearby free area. This facilitates connecting the latrine and the shed directly to the digester. It is also pereferable for the kitchen to be close to the digester at the back side of the house to reduce the length of the gas line. It is worthy to mention that all these modifications do not need any additional costs if taken initially in the design.



R-Room A-Animal Shed L-Latrine S-Store
Fig. (1) The used house model (No 81/A) in the new reclaimed desert areas

PLANNING EGYPTIAN VILLAGES IN THE NEW RECLAIMED AREAS WITH REGARD TO ACCOMMODATION OF BIOGAS TECHNOLOGY

M.A. Hamad,* M.A. EL Gammal* N.R. Mitry*

ABSTRACT

Biogas technology (BGT) can be one of the appropriate technologies in the context of the development of desert areas. A viable model is roposed for application of BGT in the new desert community areas. The model involves a novel architectural design and house planning to optimize the role of BGT as attached to the whole community and the exploitation of its energy, fertilizer and sanitation benefits.

I. INTRODUCTION

Biogas technology (BGT) has good prospects in the rural areas of most of the third world countries. It has many beneficial attributes; among of which the coproduction of energy and organic fertilizer as well as the sanitary disposal of wastes are of special interest.

The amounts of organic wastes available for digestion in rural areas of Egypt is substantial and can produce biogas equivalent to more than two million tons of petroleum oil. However, and taking account of various limiting condition, the actual expected potential of BGT was deemed much less as it would not exceed 0.9 million tons equivalent of petroleum oil (1).

The main constraint for propagation of BGT in Egypt is the cluster structure of housing in the traditional villages. The design of new villages constructed in the reclaimed desert areas, is also not suitable to extensive application of BGT. Meanwhile, Egypt is planning to reclaim more than 2.8 million acres of land by the year 2000. Thus, the reclaimed areas are anticipated to reach about 50% of the present size of the cultivated areas.

For these reasons, a model for new-planned villages is proposed in order to enhance the prospects for the utilization of BGT to the fullest possible extent in the new desert reclaimed areas. Application of this model is anticipated to allow 100% utilization of BGT, in addition to availing the possibility of complete recycling of water and organic matter.

2. THE PROPOSED MODEL

To get the most benefits of applying BGT in rural areas, certain issues have to be tackled and pre-incorporated in the plan of the the farmer house at the early stage when the whole village is being designed. Options to cope with such issues are addressed in the following.

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The results for surface jets were compared with Rajaratnam's (1984) scales for a surface circular jet in coflowing streams as shown in Figs. 1 0and 11. It is noted that the lateral and vertical velocity scales are greater than those of Rajaratnam.

CONCLUSIONS

Experimental studies were performed to investigate the behaviour of non-buoyant jets in cross-flowing ambients near the outfall where mixing zones are critical.

The experimental evidence and the similarity analysis indicate that the excess velocity profiles display similarity in the lateral and vertical directions and are best described by the Gaussian distribution; however, similarity was not achieved when strong re-attachment and recirculation occurred. A single functional behaviour of the excess velocity along the jet exists for various velocity ratios if the jet is considered after the establishment zone.

For submerged outfalls, (above the bottom), the experiments showed that there is a tendency of bifurcation in the lateral velocity profiles and this tendency increases with increasing the velocity ratio.

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Fig. (9) Similarity of vertical velocity profiles.

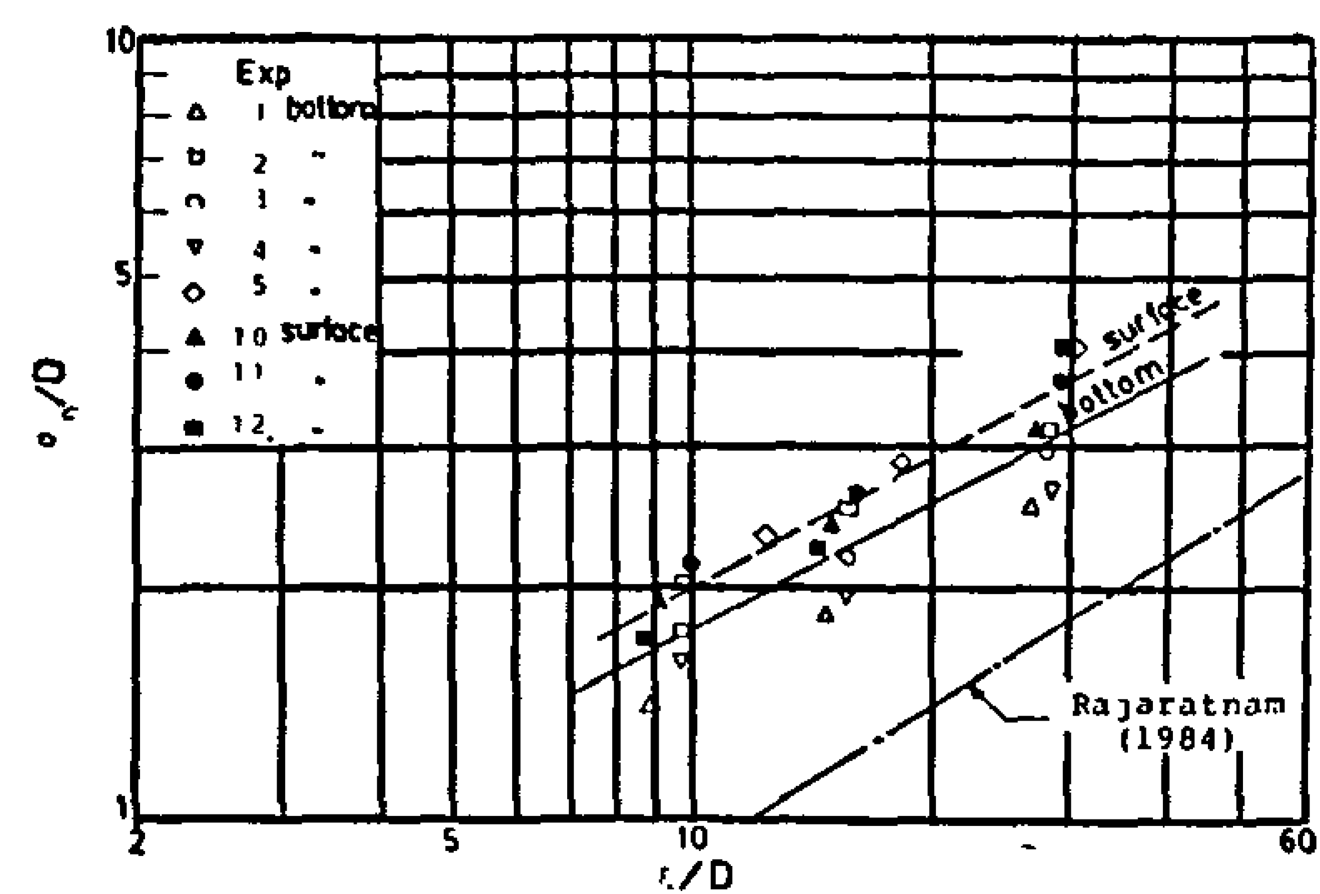


Fig. (10). Lateral length scale for velocity profiles.

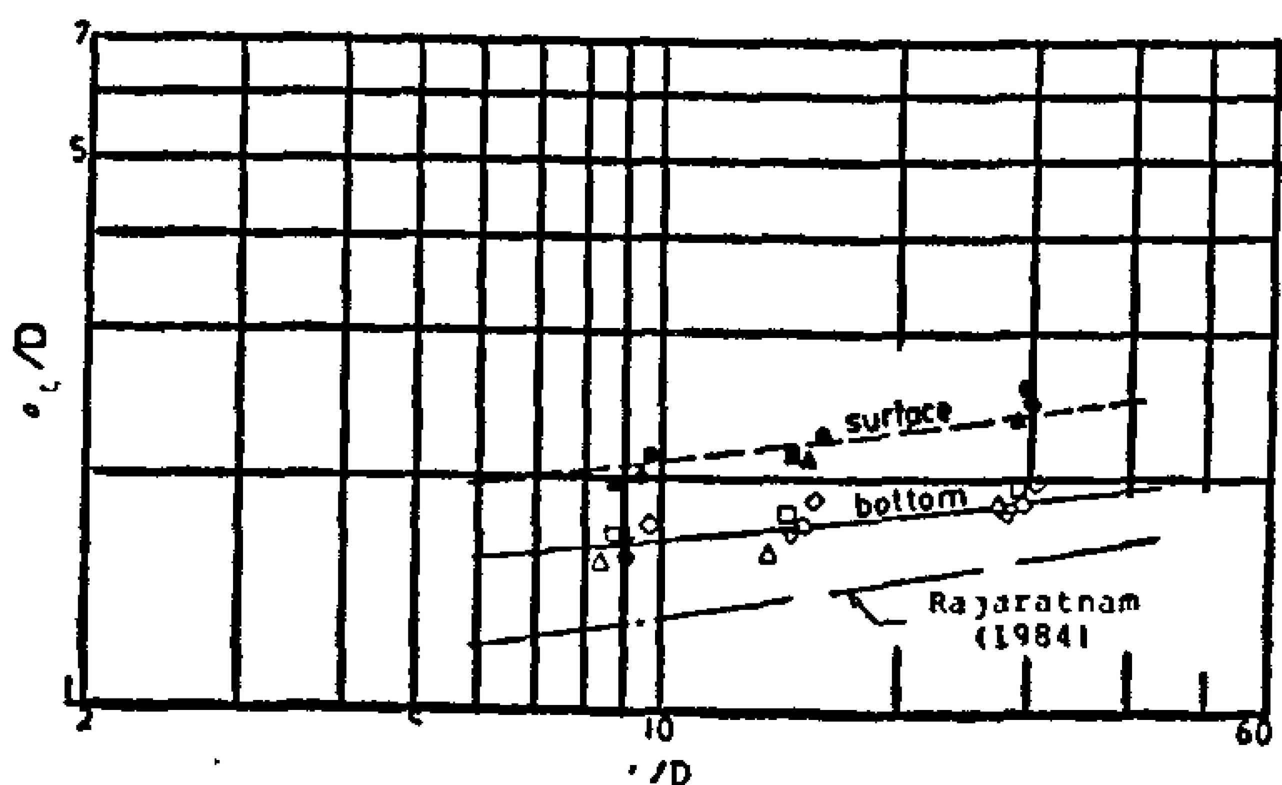
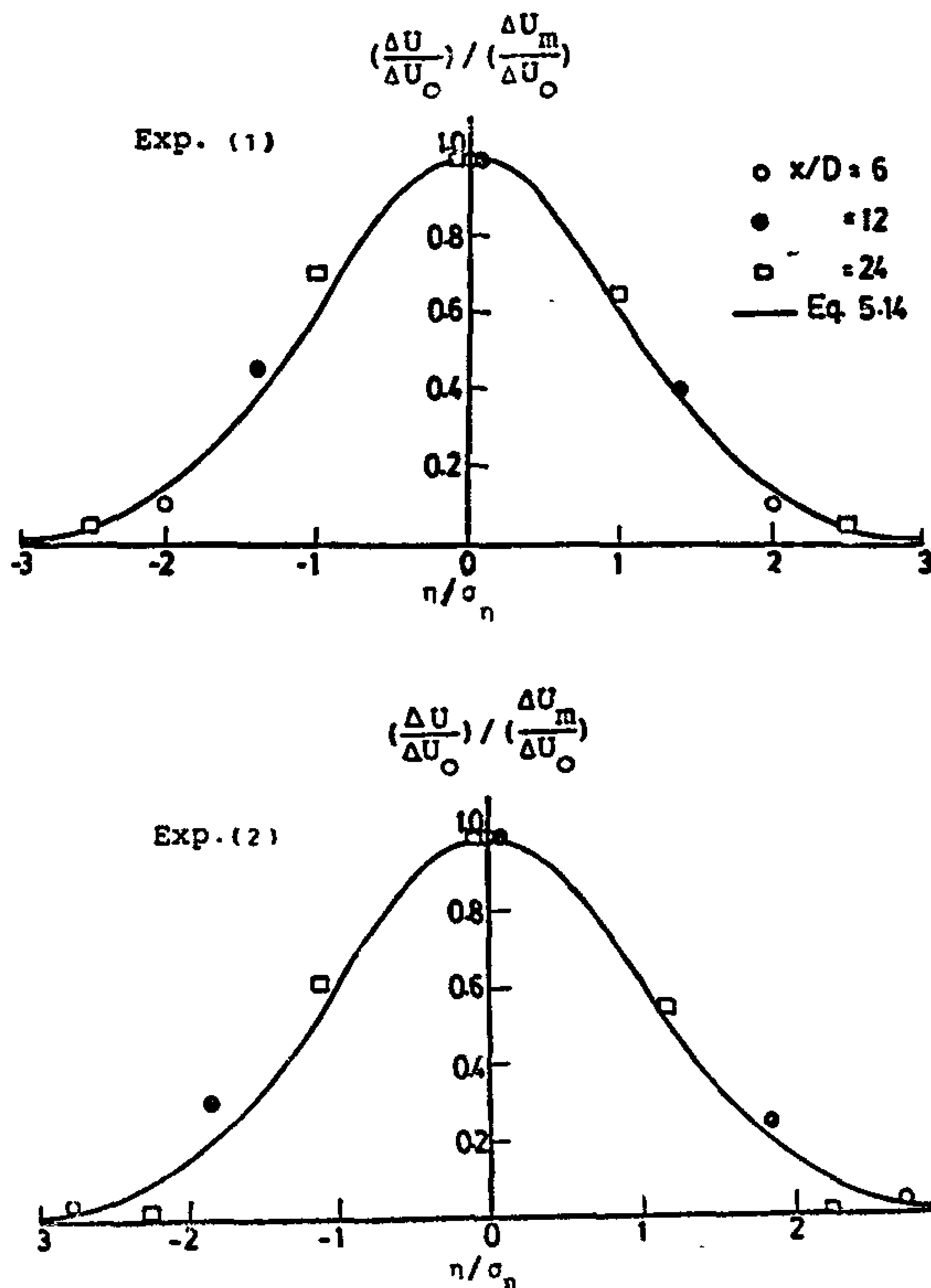


Fig. (11). Vertical length scale for velocity profiles.



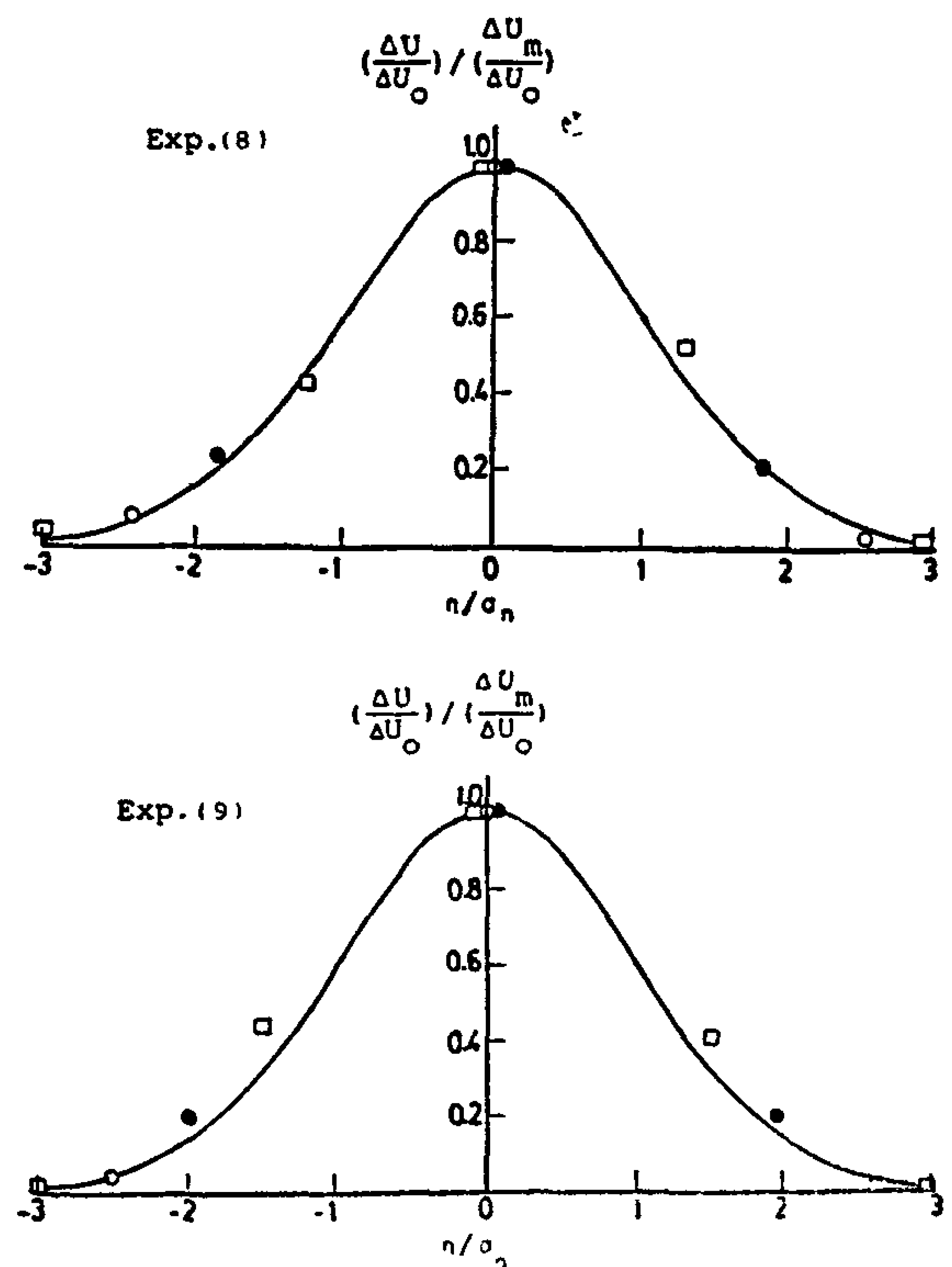


Fig. (8) Similarity of lateral velocity profiles.

profiles are similar and are best described by a Gaussian form. Similarly, it was found that the velocity profiles in the vertical direction were similar if values of $(\Delta U/\Delta U_o)/(\Delta U_m/\Delta U_o)$ were plotted against $\eta/\sigma\eta$ where η is the vertical distance and $\sigma\eta$ is the velocity length scale in the vertical direction. A typical plot is shown in Fig. 9 where a Gaussian form describes the data reasonably well. Thus the excess velocity distribution can be taken as,

$$\left(\frac{\Delta U}{\Delta U_o}\right) / \left(\frac{\Delta U_m}{\Delta U_o}\right) = e^{-0.5\left[(\eta/\sigma_\eta)^2 + (\zeta/\sigma_\zeta)^2\right]} \quad (1)$$

Variations of the lateral and vertical length scales in terms of D are shown in Figs. 10 and 11 respectively, where values of $\sigma\eta$/D and $\sigma\eta$ /D are plotted against η /D for bottom and shorebased surface outfalls.

In Fig. 10, both variations have the same trend but for surface outfall, $\sigma\eta$ increases at a rate slightly higher than that of bottom outfall. However, $\sigma\eta$ for surface outfall grows at a rate approximately 1.20 times the rate of growth of $\sigma\eta$ for bottom outfall. From Figs. 10 and 11 one can write that :

For bottom outfall,

$$\frac{\sigma_\eta}{D} = 0.51 \left(\frac{\xi}{D}\right)^{0.53} \quad (2)$$

$$\frac{\sigma_\zeta}{D} = 1.30 \left(\frac{\xi}{D}\right)^{0.10} \quad (3)$$

for surface outfall,

$$\frac{\sigma_\eta}{D} = 0.53 \left(\frac{\xi}{D}\right)^{0.56} \quad (4)$$

$$\frac{\sigma_\zeta}{D} = 1.56 \left(\frac{\xi}{D}\right)^{0.12} \quad (5)$$

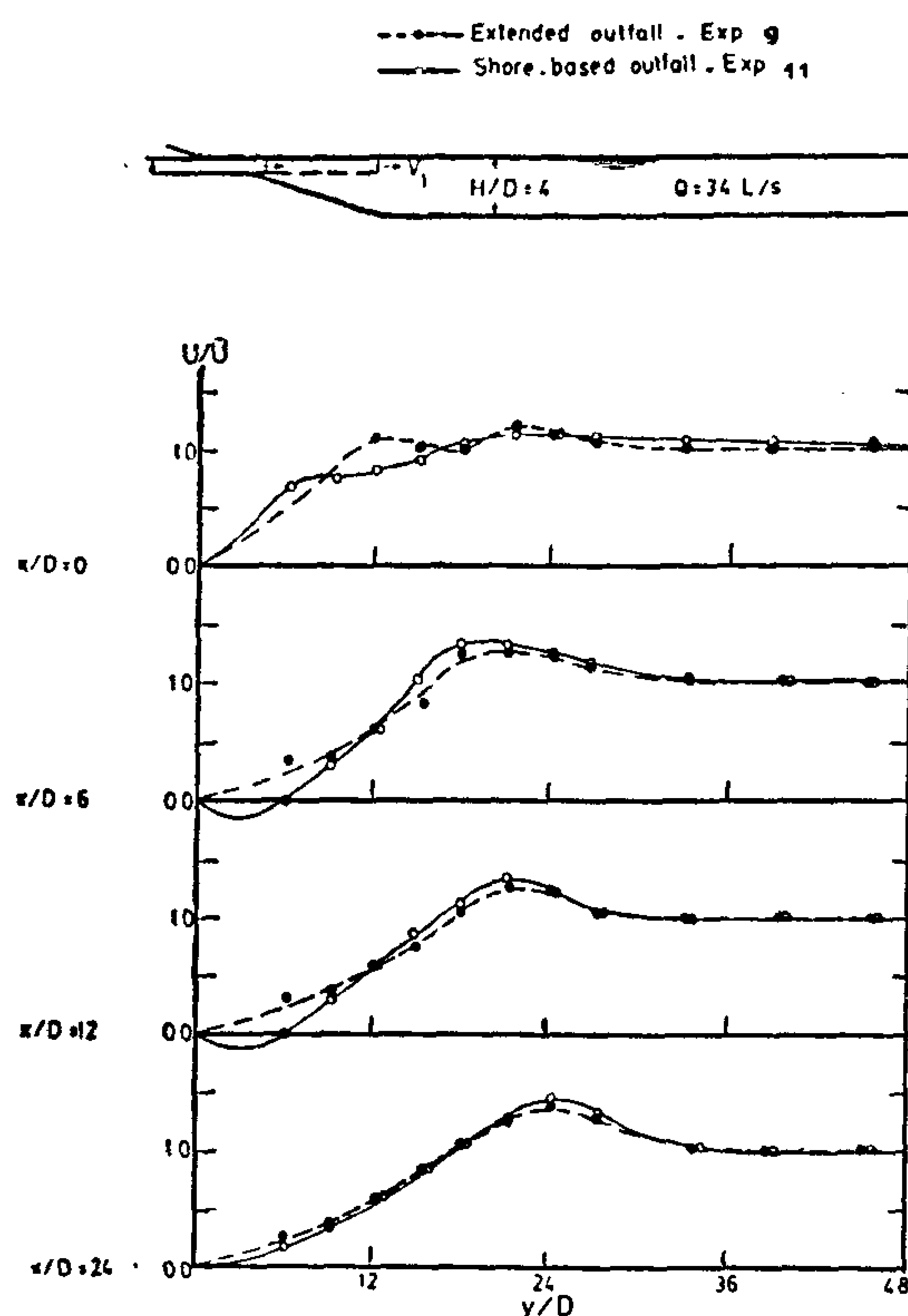


Fig. (5). Comparison of lateral velocity profiles between shore-based and extended surface outfalls-Exps. 9 and 11.

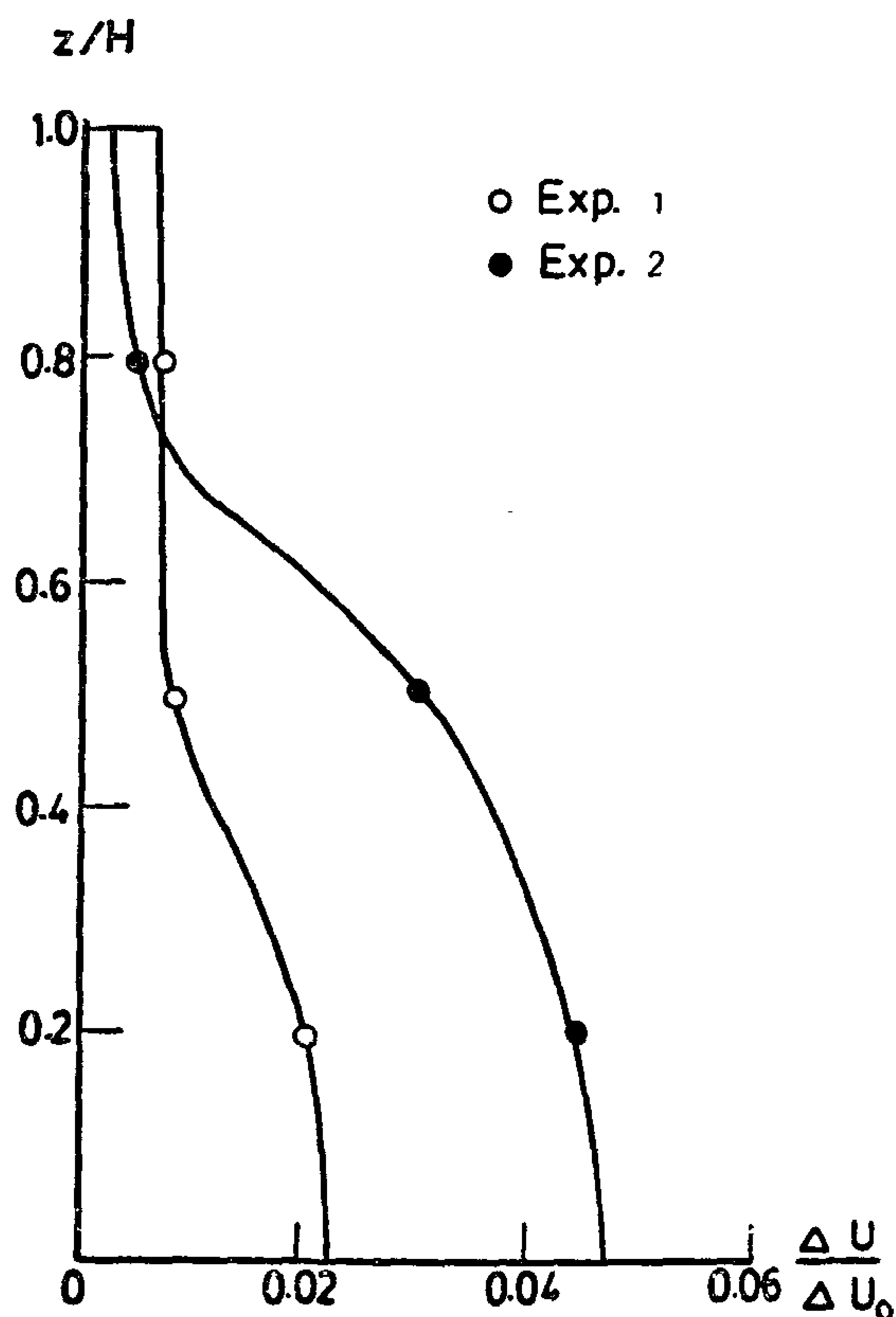


Fig. (6). Vertical excess velocity profile for bottom outfall (neutral density).

VELOCITY SIMILARITY ANALYSIS

When a jet is discharged into a stream, the local vertical velocity distributions no longer follow a logarithmic profile. This is shown in Figs. 6 and 7 where the dimensionless excess velocity U, Uo = (U - Ua)/(Vj - Ua), is plotted against relative depth, z/H for bottom and extended surface outfalls, respectively.

The dimensionless excess velocity profiles in the lateral direction were analyzed for similarity. Fig. 8 shows $(\Delta U/\Delta Uo)/(\Delta Um/\Delta Uo)$ is plotted against $\eta/\sigma\eta$ where the subscript m refers to the maximum value of $\Delta U/\Delta Uo$ η is the coordinate normal to the jet trajectory, η and $\sigma\eta$ is the standard deviation, i.e., the width at which 0.683 of the total area is enclosed by the lateral profile. From Fig. 8 it can be seen that the excess velocity

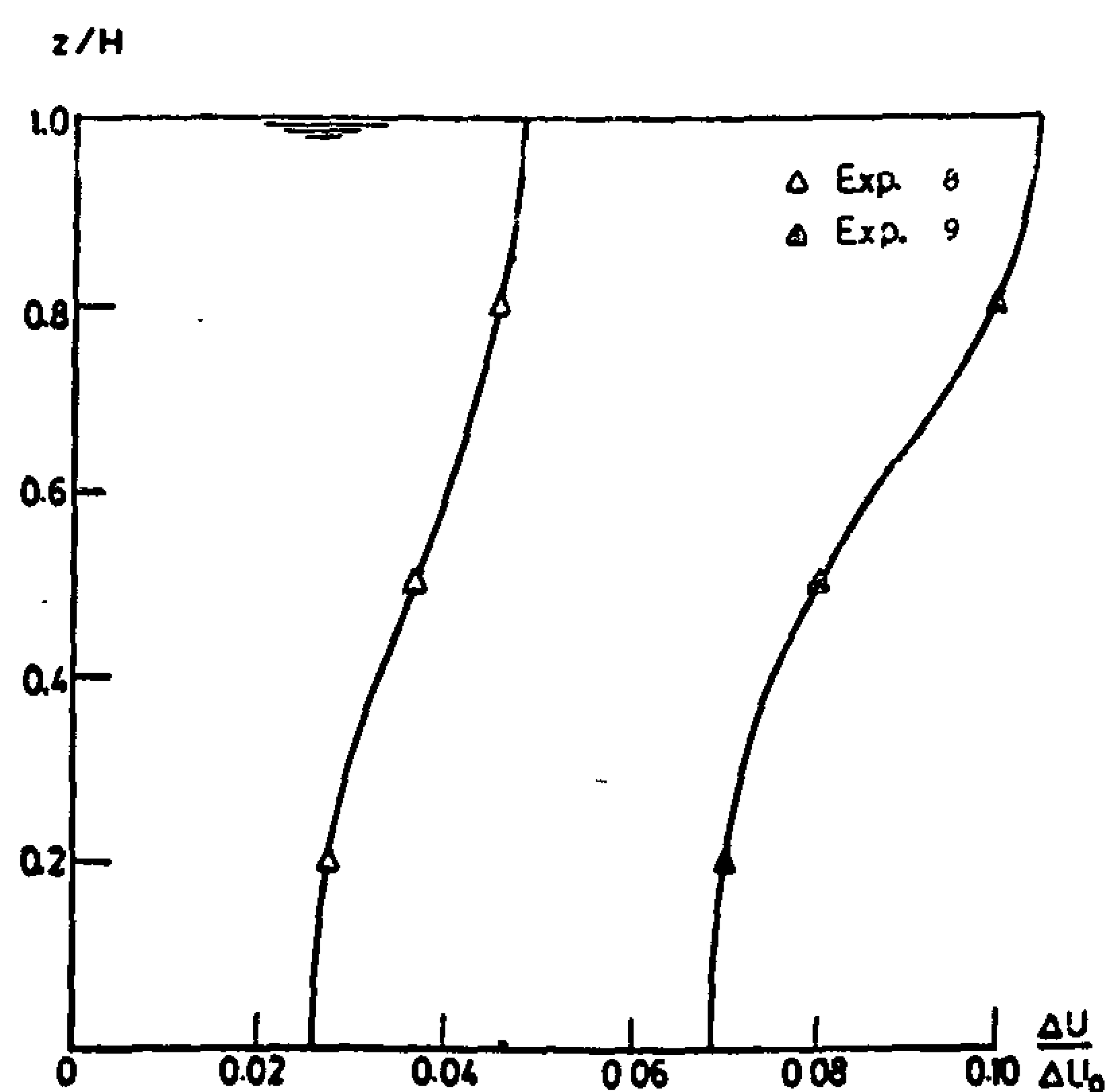


Fig. (7). Vertical excess velocity profiles for extended surface outfall (neutral density).

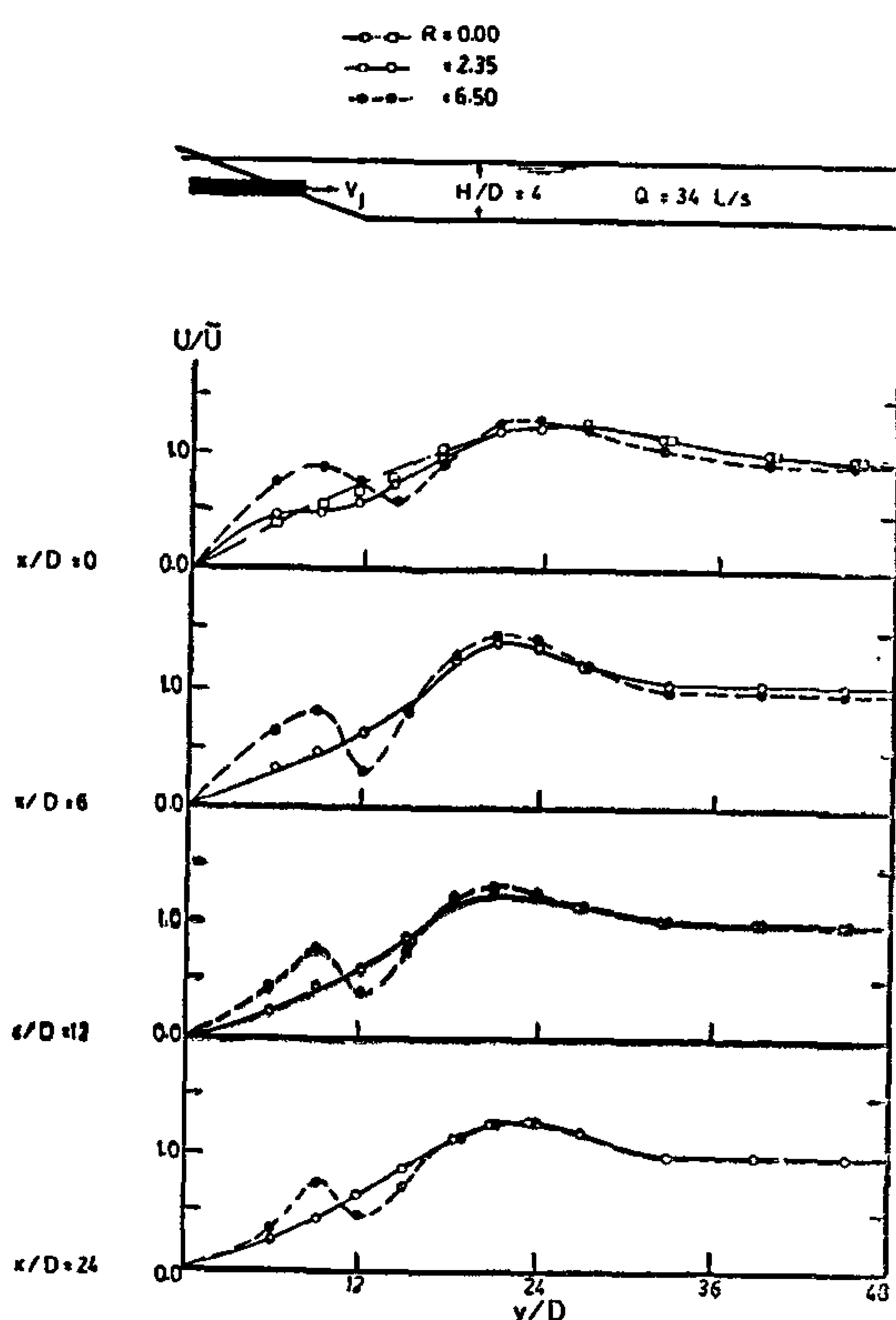


Fig. (3) Lateral velocity profiles for submerged outfall-Exps. 6 and 7.

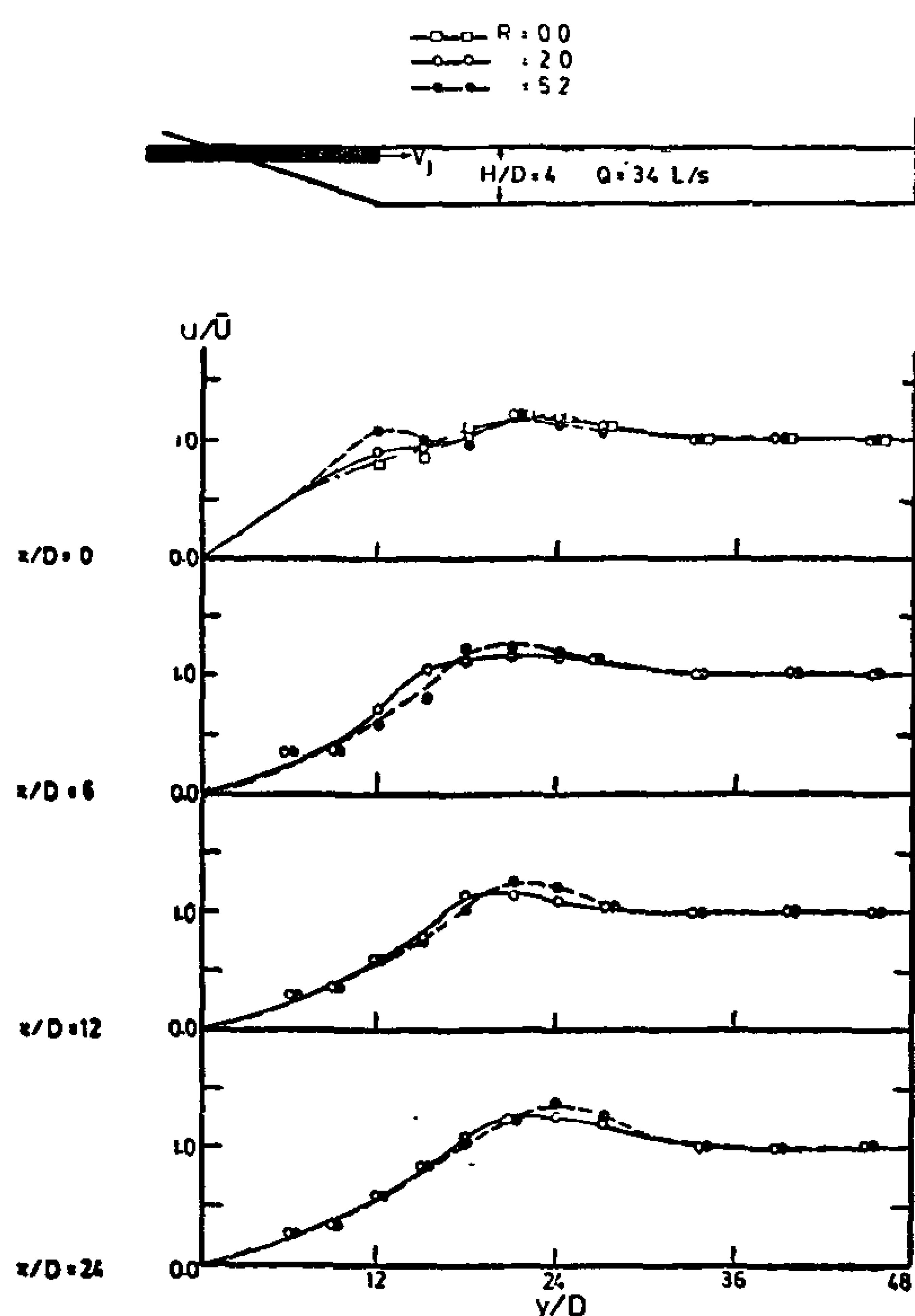


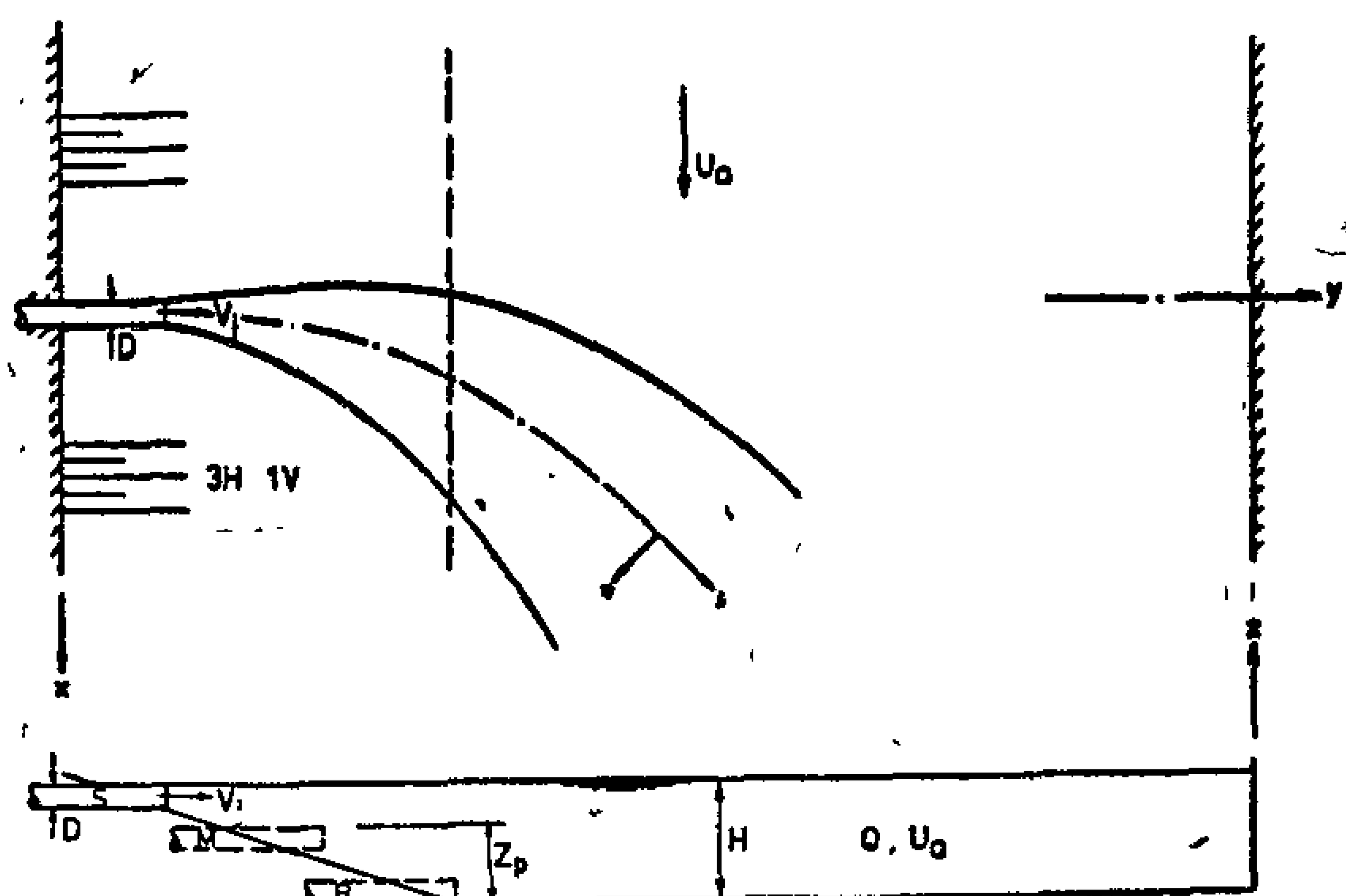
Fig. (4) Lateral velocity profiles for extended surface outfall-Exps. 8 and 9.

The velocity profiles due to jet injection from an extended surface outfall are shown in Fig. 4. Experiments 8 and 9 showed no bifurcation and the jet trajectory can be detected by tracing the locus of the maximum velocity. The extended pipe obstructs the flow and decreases the cross-flow velocity downstream from the pipe location. This is demonstrated in Fig. 4 at x/D = 6, 12 and 24 and for y/D $\leq$ 12 which corresponds to the pipe length.

COMPARISON OF EXTENDED AND SHORE-BASED OUTFALLS

In order to study the difference between the extended and shore-based surface outfall, the velocity profiles of Exps. 9 and 11 for these two cases are compared in Fig. 5. In the case of the extended outfall, the disturbance of the ambient flow is less and the velocity profile returns to the ambient profile at x/D $\geq$ 12. For the shore-based case, the velocity profile is highly nonuniform and the effect of the jet is carried further downstream to x/D $\geq$ 24. Moreover, the shore-based outfall causes a recirculation to occur at the lee side of the jet. This zone of negative velocity may have high concentrations of hazardous materials discharged through the outfall by an industry or treatment plant. Therefore, it may be advantageous to have outfalls extended a distance away from the shore so that the waste directly mixes with the receiving stream resulting in a rapid dispersion. However, the costs and maintenance involved in extending outfalls further from the shore may offset this advantage.

cation becomes stronger with distance as the two velocity maxima diverging at an angle of 5°-8°, This agrees with Rajaratnam. et al. (1980) who reported that for the experiments with R = 7.0, there are more than one maximum velocity points. Scorer (1959) and Turner (1960) had shown that a strongly buoyant plume in a cross-flow may actually bifurcate into two concentration maxima. For small velocity ratios, R ≤ 4.2, the measurements showed no bifurcation.



B = Bottom M= Middle S = Surface
Fig. (1) Definition Sketch for Experimental Set-up.

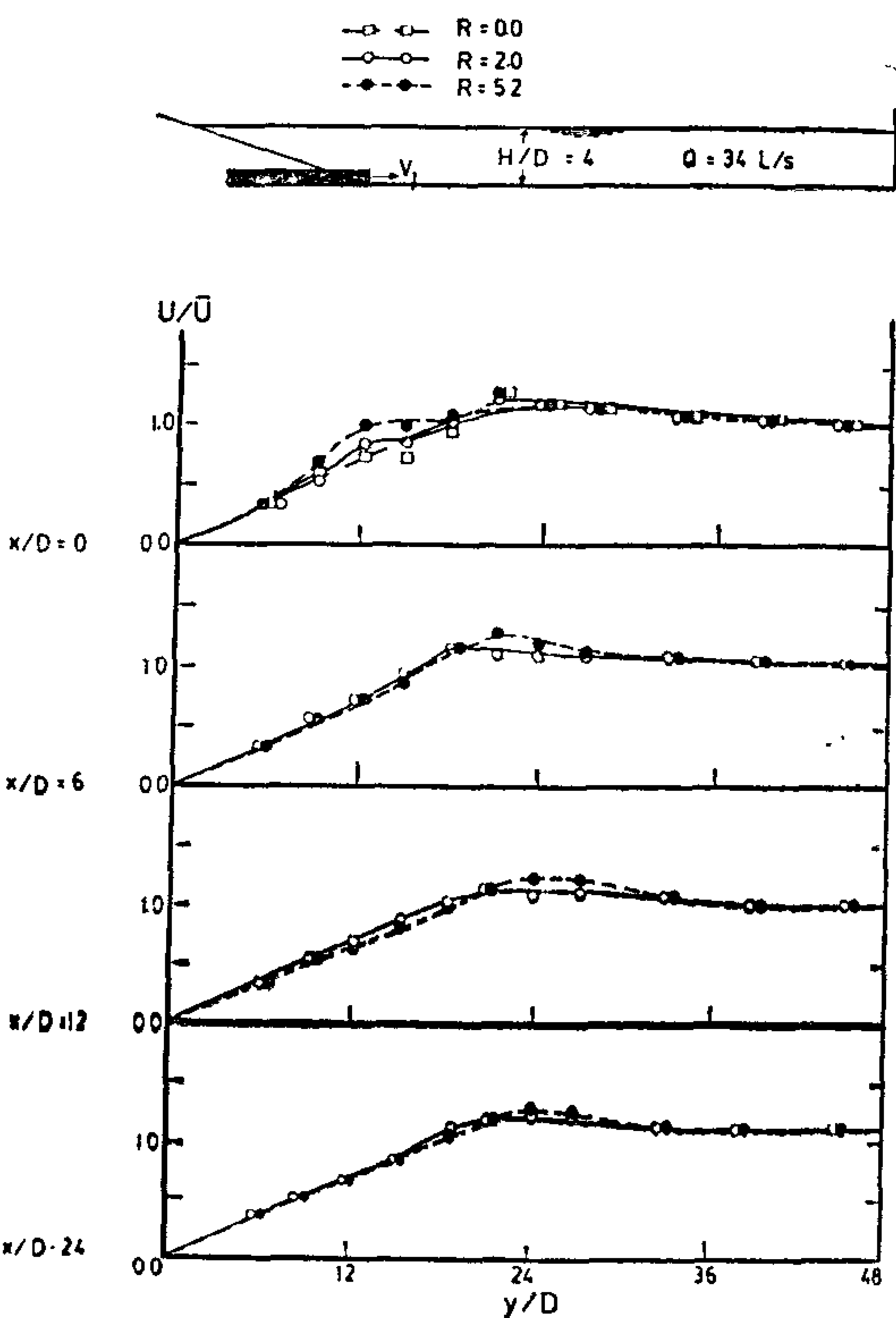


Fig. (2) Lateral velocity profiles for bottom outfall-Exps. 1 and 2.

Table 1: Significant Details of the Experiments.

Run No.	Q (L/s)	H (m)	H/D	Vj (m/s)	Ua (m/s)	R = Vj/Ua	Rn=Vj D/ x10^{3}	position
1	34	0.20	4.0	0.20	0.10	2.0	10	
2	34	0.20	4.0	0.52	0.10	5.2	26	
3	70	0.20	4.0	0.63	0.19	3.3	31.5	Bottom
4	70	0.28	5.5	0.28	0.13	2.2	14	
5	70	0.28	5.5	0.64	0.13	4.9	32	
6	34	0.20	4.0	0.20	0.10	2.0	10	
7	34	0.20	4.0	0.55	0.10	5.5	27.5	Middle
8	34	0.20	4.0	0.20	0.01	2.0	10	surface
9	34	0.20	4.0	0.52	0.10	5.2	26	(extended)
10	34	0.20	4.0	0.20	0.10	2.0	10	surface
11	34	0.20	4.0	0.52	0.10	5.2	26	(shore-
12	70	0.28	5.5	0.64	0.13	4.9	32	based)

Notice: H = depth of flow, D = diameter of pipe, Vj = Jet velocity, Ua = ambient velocity, R = velocity ratio, Rn = Reynolds number,

HYDRODYNAMICS OF CIRCULAR JETS IN CROSS-FLOW

Dr. Sameh M. Abdel-Gawad[1] and Dr. Shaden T. Abdel Gawad[2]

INTRODUCTION

In rivers which are navigable, such as the River Nile and its connecting channels, cross river velocities induced by cross discharges may be hazardous to ship and barge traffic. Most of the available literature has been concerned with measuring or predicting the jet velocity along the jet axis (Keffer and Baines 1962, Parr 1979 and Rajaratnam 1980). Little attention has been given to the actual velocity distribution across the river and the interference between the jet and the cross flow. In this paper, the effect of the jet velocity on the lateral distribution of the longitudinal velocity of the river is discussed and analyzed.

EXPERIMENTAL RESULTS

Three different sets of experiments were performed to measure the velocity distribution due to the jet injecton for different velocity ratios, discharges and relative depths (Fig. 1). Table 1 gives the significant details of those experiments. In the first set, presented in Fig. 2, the outfall was at the bottom, whereas, the second set represents a submerged outfall, (Fig. 3). In the third set, shown in Fig. 4, the outfall was placed at the surface. In Figures 2, 3 and 4, the undisturbed velocities, i.e., the longitudinal channel velocities without the jet, were plotted at $x/D = 0.0$, where D is the outfall diameter.

The effect of a bottom discharged jet on the velocity distribution is shown in Fig. 2. In this figure, the local depth averaged velocity, U, is normalized with respect to the average velocity in the cross section, U, and plotted against y/D. The locus of maximum velocity values were used as a basis for defining the jet trajectory. The maximum values, as expected, increase with increasing the velocity ratio, R. The normalized velocity, $U/\overline{U}$, is seen to decrease along the path of the jet from a maximum value to eventually merge with the undisturbed channel velocity. Also, the velocity induced by the jet decreases with the longitudinal distance to eventually attain the channel velocity at $x/D \geq 24$.

The normalized velocity profiles for a submerged outfall as measured across the channel are shown in Fig. 3 for different parameters. In this case, the ambient cross-flow decelerates as it approaches the jet boundaries as if it was being blocked by a rigid obstacle, except that the boundaries of the jet are compliant and entraining (Moussa et al. 1977). Some experiments showed that there is a tendency of bifurcation in the velocity profiles and this tendency increases with increasing the velocity ratio R. In Fig. 3 and for $R = 6.5$, the jet bifurcates into a pair of vortices leading to two velocity maxima. This bifur-

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of shallow but dense wells in the available stretch, that conects water in tanks and then pumps this water through high pressure pipes to the city. Water obtained by this system does differ significantly in quality compared to normal current water in Ismailia canal. Additional investment in such system is not justified. Direct pumping from Ismailia canal will produce the same quality without spending wells construction costs. Thus benefit/cost analysis of this well system shows lucidly that no additional benefit is gained from such system, The system, therefore, is economically infeasible.

6. CONCLUSION

Water needs for the El-Obour City are mainly directed towards domestic consumption, potable water for irrigation and industral water uses. One of the possible sources of this water demand is to construct a system of wells nearby Ismailia Canal that collects more filtrated water than in the canal. This water can then be gathered in tanks and pumped for use with lesser treatment and purification. Technical feasibility of such proposed system is the main isue of this study.

It is shown using data available for the region and experimental investgations of both water and soil sampies in the study area from Km 35 to Km 45 on Ismailia Canal that: i) Water that can be collected from this suggested well system nearby Ismailia Canal by seepage is very limited compared to the necessary demand (ranges 5.0 - 8.0% of total requirement); ii) Water obtained from this proposed system does not appreciably differ in quality from normal current water in Ismailia Canal possessing no further purification; and iii) The system, besides being economically costly, it will disturb water flow in the area full of irrigation lands and inhabitants, using this groundwater resource.

Therefore, it is concluded that the concept of constructing well system nearby Ismailia Canal for obtaining more filtrated water to El-Obour City should be disregarded. Direct water intake from Ismailia Canal remains to be the most suitable for this situation.

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5. TECHNICAL FEASIBILITY OF THE WELLS SYSTEM NEARBY ISMAILIA CANAL:

It appears from Table (2) that the total amounts of seepage from the Ismailia canal along 4 Km stretch of canal, which is the only part available for wells construction are:

Water level Condition	Present Condition	1st Stage	2nd Stage
High	$34.8x10^3$ m^3/day	$44.0x10^3$ m^3/day	$52.4x10^3m^3$/day
Low	$32.0x10^3$ m^3/day	$42.0x10^3$ m^3/day	$50.4X10^3m^3$/day

This 4 Km stretch of the canal represents the region where no irrigated lands are existing or human settlements that are now utilizing this resource. The stretrh is located at both sides of the proposed water intake at Km 38.5 on Ismailia canal.

Nevertheless, several constraints may limit the full utilization of the above calcualted amounts of seepage. These constraints may be outlined as follows:

(i) The Ismailia canal at this stretch (from Km 37 to Km 39) is bounded on the left-hand side by a sewage drain, named Billbeis drain, as illustrated in Fig. (2). This drain is a main source of contamination for both the fresh seepage water from the canal and the groundwater underneath the canal.

(ii) The existence of saline water underlying the groundwater [6]. Thus, an extreme caution should be given to these configuration of the pumping rate of propsoed production wells. As the propsoed production wells are assumed to be drilled only on the eastern side of the canal, one-half of the above calculated seepage will be considered in order to avoid the up-coming of the contaminated water from the Bilbeis drain or upconing of the saline water.

In addition, due to the effect of pumping operations (cones of depressions) as well as the distances apart between the proposed wells, considerable amounts of the available seepage water will be unrecoverable. These amounts may be of the order of 30% to 50% of the total available seepage water.

Thus, the veasible amount of seepage water along the 4 Km stretch of the canal, that are only available for the propsoed well system that takes into consideration all the above mentioned constraints, will be of the following orders:

Water level Condition	Present Condition	1st Stage	2nd Stage
High	$10.3x10^3m^3$/day	$13.2x10^3m^3$/day	$15.6x10^3m^3$/day
Low	$9.5x10^3m^3$/day	$13.0x10^3m^3$/day	$15.0x10^3m^3$/day

Since the propsoed demand of El-Obour is equal to $189x10^3m^3$/day, it is apparent that the veasible amount of seepage water at the present time as well as after the first and final stages of enlargement of the Ismailia canal can not satisfy the demand of the El-Obour city. Cost of this propsoed wells nearby Ismailia canal is high. It requires a system

Table (5) Quality Standards for Drinking water and Chemical Characteris- tics for Raw water for El-Obour.

Drinking water standards- Chemical Properties (mg/l except PH)					Raw water El Obour ISM CAN,KM. 38
Parameter	EPA	WHO	ARE [a]	Recommended	Actual
Lead (pb)	0 05	0 1	0 1	0.1	0.412
Cyanide (CH)	–	0 05	0 05	0.05	–
Seleniun (Se)	0 01	0 01	0 01	0 01	–
Arsenic (As)	0 05	0 05	0.05	0 05	–
Codmium (Cd)	0.01	0 01	0 01	0 01	0.025
Mercury (Hg)	0.002	0.001	0.001	0.001	–
Fluoride (F)	V[b]	V	0.8	1 8	–
Nitrates (NO)$_3$	45	45	45	45	0.227
Total Dissolved Solids	550	1500	1500	1500	1450
Iron (Fe)	0.3	1.0	1 0	0. 3	0.471
Manganese (Mn)	0.05	0 5	0.5	0.05	0.021
Copper (CU)	1.0	1 5	1.5	1 5	0.026
Zinc (Zn)	5	15	15	5	0.243
Calcium (Ca)	–	200	200	200	24 6
Magnesium (Mg)	–	150	150	150	15 0
Hardness ($CaCO_3$)	–	500	500	500	–
Chloride (Cl)	250	600	600	250	16.1
Sulphate (SO_4)	250	400	400	250	–
Phenol	–	0.002	0.002	0.002	–
PH (Range)	6.9-8.5	6.5-9.2	6.5-9.2	6.5-9.2	8.34
Chromium (Cr^{+3})	0.5	–	–	0.5	–

(a) Existing standard states-water shall be free of toxic substances if found, shall not exceed the following limits.

(b) Variable.

(c) United States Public Health Service recommends TOS of not over 550 mg/1.

Table (3) Concentration of Heavy Elements in the Samples Taken Near the Ismailia Canal and The Industrial Area of Mosturod and Shoubra El Khema (Micro GM/L) [4].

Site Number	Cu	Zn	Pb	Fe	Mn	Ne
45*	L. D	64	70	333	380	L.D
48*	110	2468	478	5430	2060	L.D
49**	130	2357	237	4178	2190	L.D
50**	42	6456	70	3663	69	L.D
52**	67	341	127	11443	94	L.D
56*	L D	80	L.D	333	L D	L.D
57*	67	268	291	33777	156	L.D
58*	40	62	68	10100	156	L.D
59**	L D	8987	1764	6438	656	L.D
62**	50	9367	418	8658	406	L.D
75**	67	962	L.D	10545	940	L.D

L.D Low detection.
* Well.
** Piezometer.

Table (4) Analysis of Water Samples

NO	Sample location	PPm						E C m mhos	PH
		K	Na	Cu	Mn	Fe	Zn		
1	From a hand dug well 50 m South El Gabel El_Asfar Drain.	2 76	16.5	0.2	0.5	0.67	0.16	1.79	7.35
2	From Belbies Drain at El_Shahafa.	1.69	11.4	0.2	0.4	0.38	0.06	1.14	7.52
3	From Ismailia Canal at El. Shahafa.	0.66	3.52	0.4	0.2	0.33	0.02	0.40	7.95
4	From a hand dug Well 40 m East of Ismailia Canal.	1.27	5.4	0.2	0.5	0.33	0.08	0.73	7.84
5	From a hand dug well 120 m East Ismailia Canal.	1 01	2.98	0.2	0.3	0.33	0.08	0.42	7.97
6	From ahand dug well 100 m East Ismailia Canal at EL Zwamel	1 17	7.67	0.2	0.9	0.33	0.06	0.78	7.65

lected from different wells in order to study the water quality and the sources of contamination. The samples were analyzed in the National Research Center in Cairo to determine the concentrations of Zn, Fe, Mn, Cu, Na, and K. The electric conductivity and PH level of samples have also been estimated. Table (4) elucidates the samples sites and the corresponding concentrations of the chemical substances.

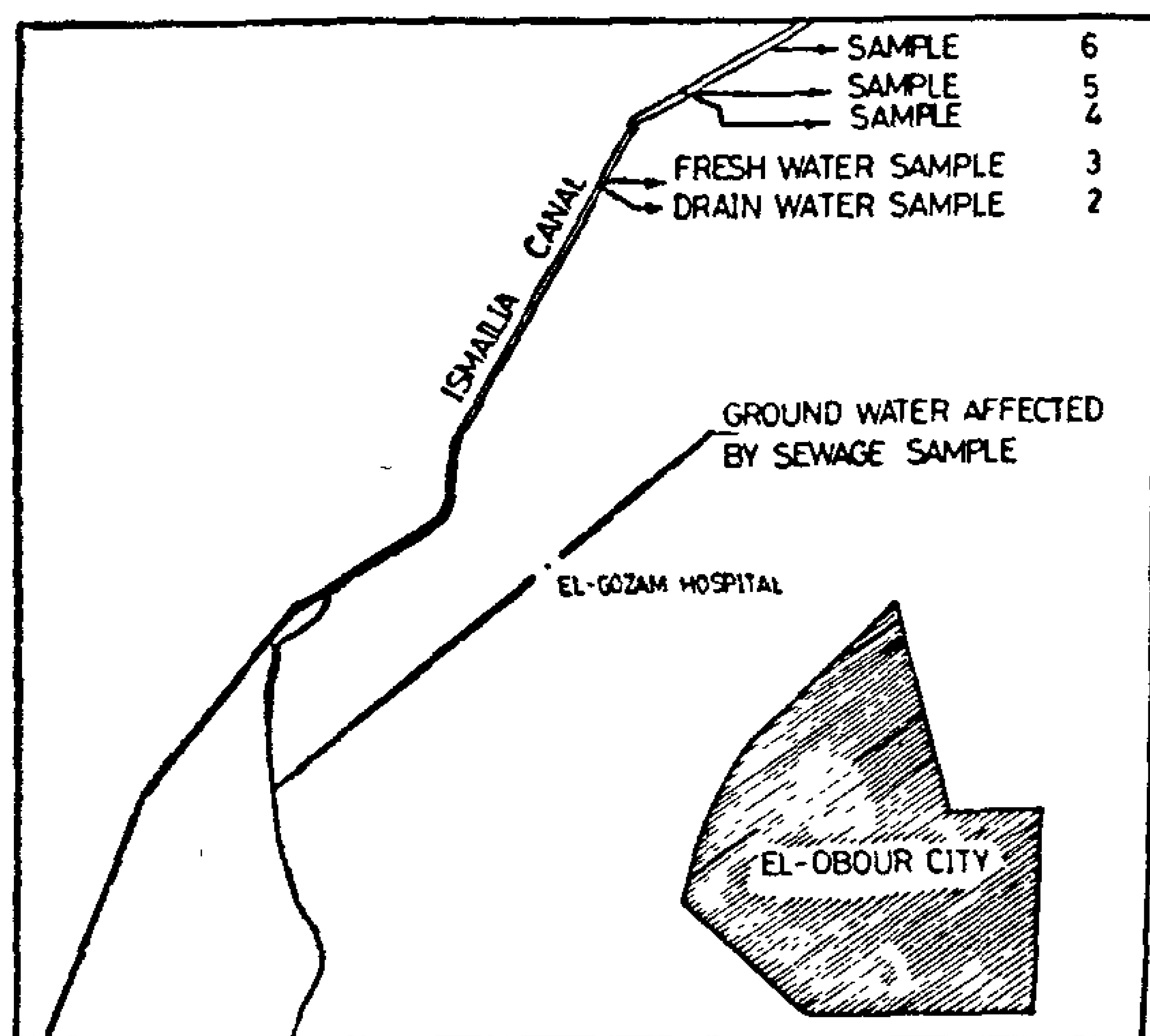


Fig. (6) A Map Showing Locations of Water Samples Obtained For Contamination Studies.

The standard range of PH level of potable water vires from 6.5 to 9.2. Meanwhile, the water quality analysis of this study revealed that the level of PH is 7.95 for the Ismailia canal water at El-Sahafa. Nevertheless, all samples indicate that the PW levels are within the standard range as shown in Table (3), (4).

The collected measurements of chemical concentrations taken in different sites nearby the Ismailia canal are compared with the standards of the potable water. These standards are documented in an analysis reported in the Master plan study of El-Obour City (1983) and given in Table (5). The concentrations of chemical depositions from Zn, Fe, Mn and Cu are within the standards except the concentration of Mn, at El-Zwamel well (100m from the Ismailia canal at Km 38). The concentration of Mn at that site is 0.9 mg/L while the standard value is 0.5 mg/L.

The electric conductivities of the collected samples were also determined to measure the salinity level. As elucidated in Table (4), the maximum level of 1.79 mmhos/cm has been attained at El-Khanka groundwater sample. Meanwhile, the minimum value has been found in the water sample of the Ismailia canal at Km 38. This value amounts to 0.4 mmhos/cm. This analysis showed also that the salinity of groundwater nearby the K 38 at Ismailia canal is relatively large compared to that of the canal. It has also been observed that level of salinity increases with the distance of sample site from Ismailia canal.

In order to evaluate the chemical deposition of the Ismailia canal soil, a soil sample was obtained from the deposits that were taken from the canal bed at Km 38 during the time of cleaning the Ismailia canal. The quality analysis of this sample is given in Table (4). It was found that this sample contained high levels of concentrations of the heavy metals due to the industrial activities in the area. However, the concentration of these metals are within the range of the concentration limits of the agricultural lands.

The concentrations of Na and K in the samples taken from the wells near the Ismailia canal are relatively high, as illustrated in Table (4). The minimum value of K is 0.66 ppm at Km 38. This indicates that the cost of water treatment of El-Obour City can be reduced when the Ismailia canal is prepared to feed the city directly by fresh water. This is on the contary to the previous premise that the proposed wells system nearby the canal collect more filtrated water than in Ismailia canal.

Tere are also available results of some test wells carried out in previous nvestigations at the location of the proposed water intake (Km 38.5 at Ismailia canal). These wells are located at distances of 30 m and 140 m from the canal. Lithology of the of the wells near surface indicated that the surface is clayey sand followed by sand clay. Therefore the value of 0.133 m/day as hydraulic conductivity is a good conservative representation.

The hydraulic parameters of the Ismailia canal cross-section are shown in Fig. (5) The quantity of seepage rates as well as the hydraulic cross-section parameters are given in Table (2).Itt can be seen from Table (2) that the total volume of seepage per Km from the canal cross section is equal to 8.7 x 10^3 m^3/day/Km (High water level) 8.0 x 10^3 m^3/day/Km (Low water level) at the present condition. The total seepage rate per Km will be 11.0 x $10^3 m^3$/day/Km (High water level) and 10.5 x 10^3 m^3/day/Km (Low water level) after the first stage of enlargement project. After the final stage of enlargement, the total volume of seepage per Km will be 13.1 x 10^3 m^3/day/Km (H.W.L) and 12.6 x 10^3 m^3/day/Km (L.W.L). It should be observed that the above seepage calculations are based on the existing and future hydraulic crosssections of Ismailia canal as given in Fig. (5). These seepage calculations are approximately the same as those obtained by Energoproject in the Mullak report which amounted to 10.0x10^3 m^3/day/Km of canal [2], [3[.

4.3 Sources of Contamination Near Ismailia Canal :

The main sources of contamination near the Ismailia canal are due to the industrial activities along the canal. The seepage from Billbeis drain is another source of contamination of the groundwater near the Ismailia canal. There are more than twleve industrial activities that deposit their waste waters in Mostorud drain. The Acadamy of Scientific Research and Technology (1984) evalauted the water quality of many wells around the Ismailia canal [1]. It was concluded tfat the concentrations of the heavy metals were relatively large. This is due to the movment of this metals through pathways underneath the Ismailia canal, thus poluting the groundwater. The locations of the investigated water samples are located in Fig. (6). The corresponding concentrations of different chemical compositions are presented in Table (3).

Several samples of water were also taken by the team from the Ismailia canal and the Bilbeis drain at different sites near Km 38, in December 1984, See Fig. (6). Furthermore many samples were also col-

Table (2) Seepage Rate From Ismailia Canal at Km. 41.

	Water Level Condition	Canal Bed Width (m)	Canal Side Slopes H • V	Canal Water Depth (m)	Canal Breadth (m)	Seepage Rate m^3/day / Km.
Present Condition	High	36.0	2 : 1	4.12	52.48	8.7 X 10^3
	Low			3.49	49.96	8.0 X 10^3
1st Stage	High	47.0	2 : 1	5.03	67.12	11.0 X 10^3
	Low			4.40	64.60	10.5 X 10^3
2nd Stage	High	60.0	2 : 1	5.28	81.12	13.1 X 10^3
	Low			4.65	78.60	12.6 X 10^3

K = 0.133 m/day.

ject is shown in Fig. (5). This trapezoidal section represents the Ismailia Canal cross-section from Km 37.8 to Km 46. As shown from Fig. (5) at the present condition, the section has a bed width of 36.0 meters, side slopes of 2:1, and a maximum water depth of 4.12 meters. In the first stage, the bed width and the maximum water depth will be 47.0 m and 5.03 m, respectively. The bed width and the maximum water depth after the final stage of enlargement will be 60.0 m and 5.28 m, respectively, for this section.

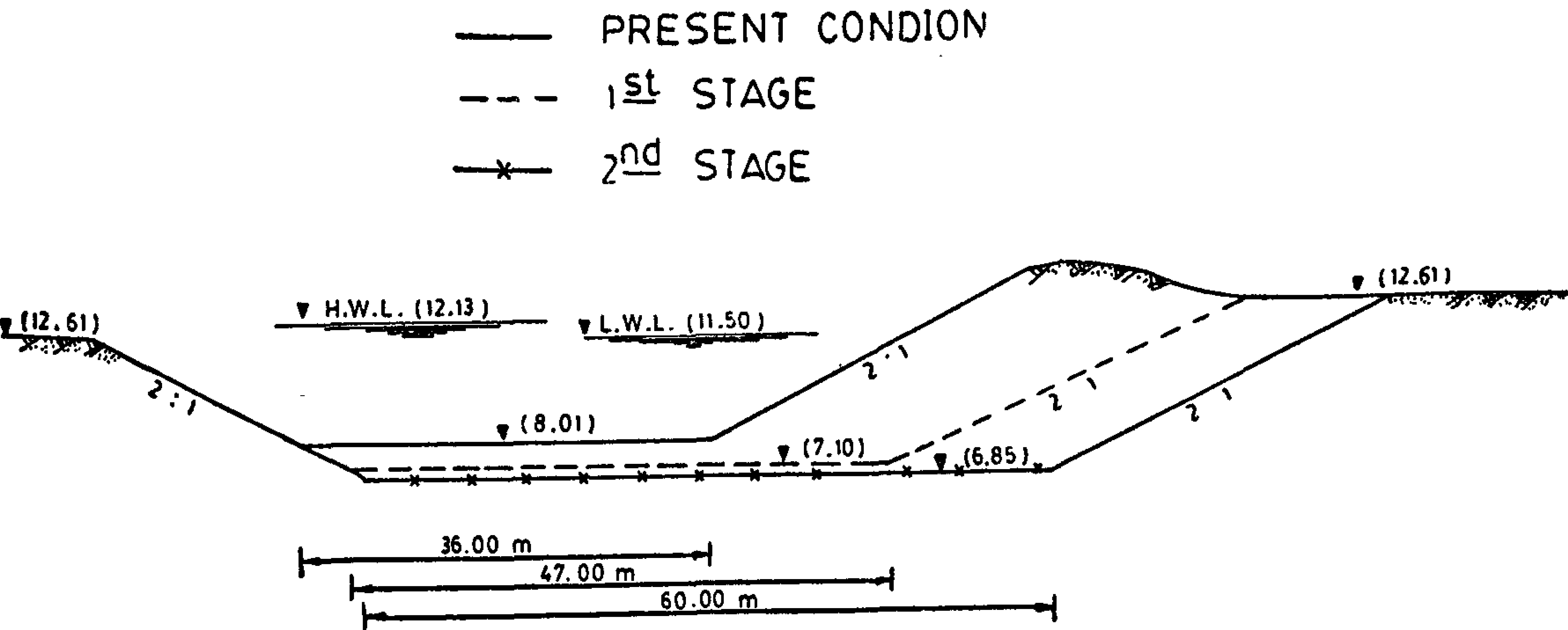


Fig. (5) Ismailia Canal Cross Section at Km. 41 (This Section Represent the Canal Cross-section From Km. 37.8 to Km. 46).

The enlargement of Ismailia canal will naturally affect the seepage from the canal. Thus, it should be considered in estimating the quantity of seepage from the canal along the area of interest.

4.2 Seppage Rates From Ismailia Canal:

The seepage flow quantity from a typical trapezoidal cross-section of canalor drain can be calculated as:

$$q = K (B + AH)$$

where q is he total seepage rate from typical trapezoidal cross-section per unit length, K denotes the hydraulic conductivity of the soil, B indicattes the water surface width, H is the water depth, and A is sespage coefficient that depends upon the ratio B/H and the angle of the side slope a.

The quantity of seepage from the Ismailia canal along the area of interest can be calculated using the above equation. Soil samples were taken by the team from the canal bed to determine the value of hydraulic conductivity. The values of K were found in laboratory as shown in Table (1). At Km 39, this value amounts to 0.133 m/day, which will be the figure incorporated later in the calculations.

Table (1) Permeability of Soil Samples

NO	Location of Sample on Ismailia Canal (Km)	Hydraulic Conductivity K = (cm / hr)	Intrinsic Permeability (U^2)
1	12.0	3.142	0.794
2	13.7	0.631	0.160
3	15.1	7.749	1.959
4	18.6	0.863	0.218
5	20.7	2.241	0.567
6	22.7	1.267	0.320
7	24.9	0.756	0.191
8	27.0	1.550	0.392
9	30.8	4.303	1.088
10	32.5	1.698	0.429
11	34.0	0.706	0.179
12	36.2	0.576	0.146
13	38.0	3.157	0.798
14	39.0	0.554	0.140
13	40.1	3.207	0.811
15	42.2	1.292	0.327
17	44.2	6.318	1.597
18	461	0 492	0 129

Water is diverted into the canal from the Nile north of Cairo City. The canal follows the natural topographic slope break between the delta and Eastern Desert to Temsah lake with a length of 128.4 kilometers.

The Ismailia canal was dug since more than one hundred years ago. Till the year 1954, the maximum water discharge passing the canal was about 5.9 x 10^6 m^3/day and the total served area was 196 500 Feddans [2]. The Ismalia canal since 1959 was enlarged twice. The first enlargement was in 1957 while the second enlargement was in 1964. In the present time, the maximum water discharge passing in the canal is 14.82 x 10^6 m^3/day and the total served area is about 395,000 Feddans. Fig. (3) deplicts the Ismailia canal discharge during the period from 1972 to 1982. The mean annual discharge of Ismailia canal is plotted in Fig. (4). Another enlargement project for the Ismailia canal cross-sections is going on now for the Irrigation of an extra new land reclamation of 70,500 Feddans. The extra land area are located east and west the Suez canal. The enlargement project of Ismailia canal will follow different stages. The canal cross-sections after the final stage of enlargement will permit a maximum water discharge of 38 X 10^6 m^3/day and serve a total area of 1,100,000 Feddans.

The enlargement project of Ismailia canal is carried out on two stages, as follows:

First Stage:

In the first stage which is considered as a temporary stage, the canal cross-sections will be enlarged from the right side so that it can pass the proposed disharge for the irrigation of a total area of 705,000 Feddans. After the end of the first stage, the Ismailia canal hydraulic section will have a bed width of 43 meters at the canal intake with a water depth of 5.2 meters. At the end of the canal, the bed width will be 12.0 meters with a water depth of 3.22 meters.

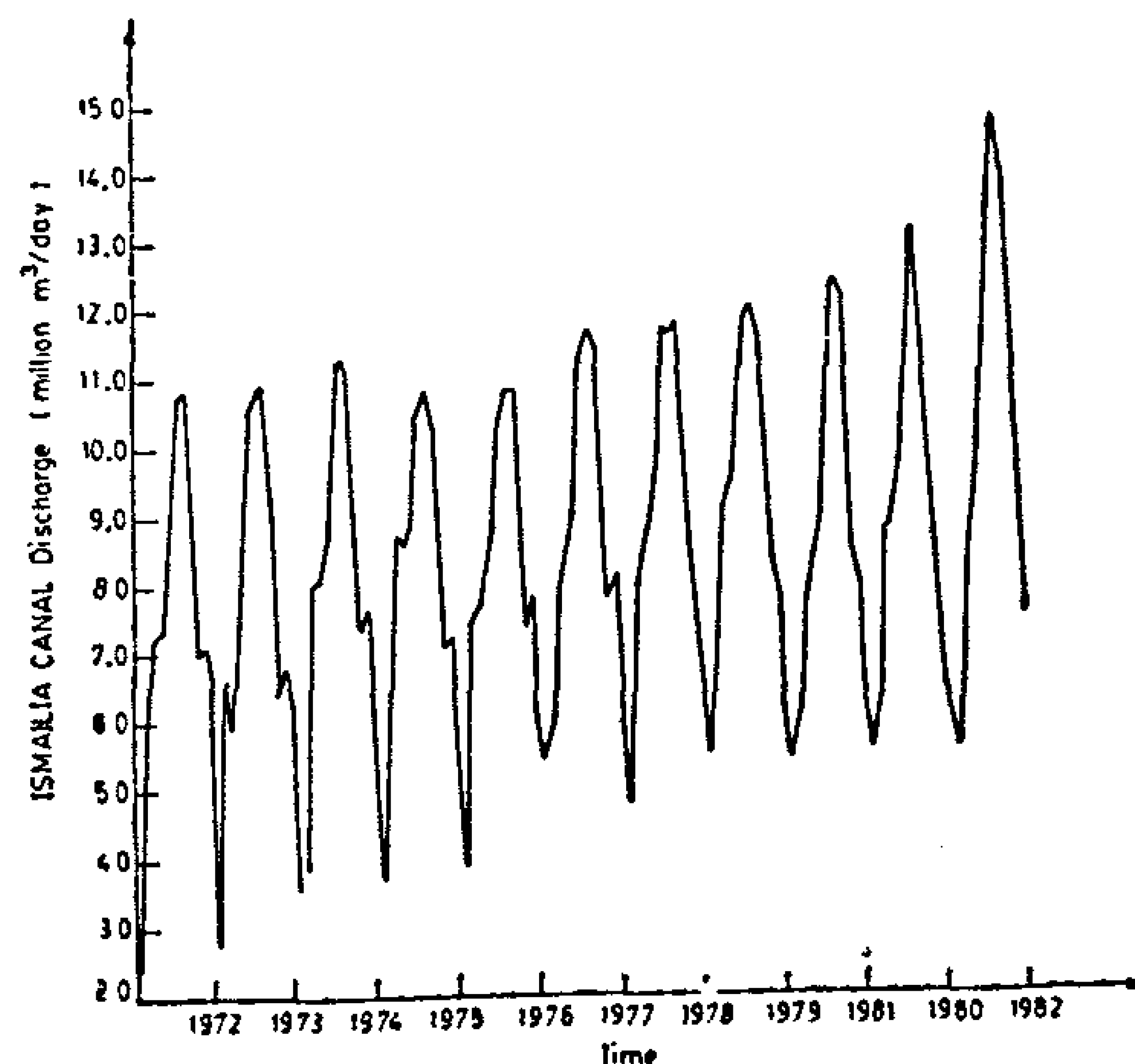


Fig. (3) Ismailia Canal Discharge Hydro-Graphs During The Period 1971-1982.

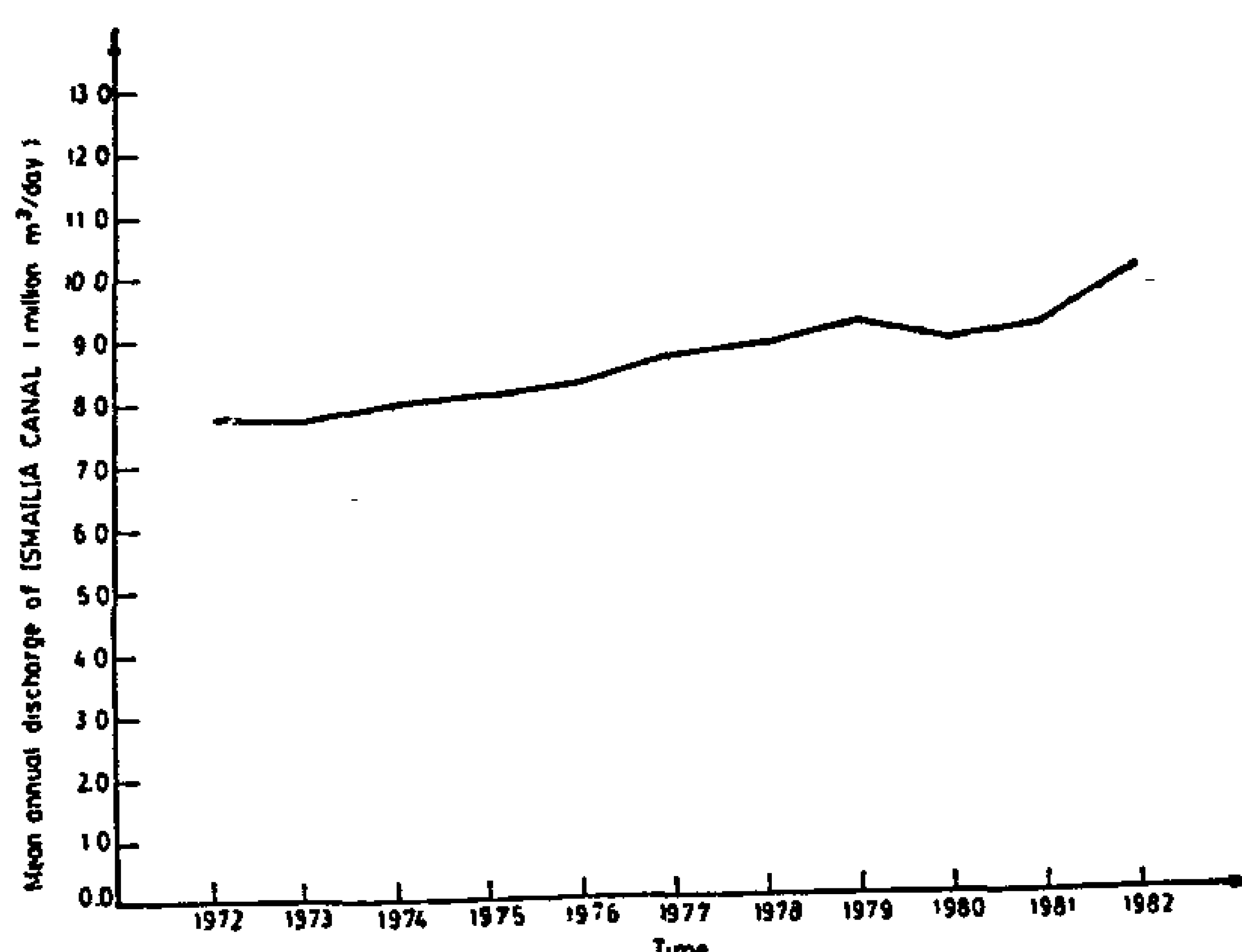


Fig. (4) Mean Annual Discharge of Ismailia Canal During the Period 1971-1982.

Second Stage:

After the end of the second stage, the canal will be finally enlarged to serve an area of 1,100,000 feddans passing a maximum discharge of 38 X 10^6 m^3/day. The final hydraulic section will have a bed width of 60 meters at the canal intake with a water depth of 5.5 meters. At the end of the canal, the bed width will be 25.0 meters with a water depth of 3.50 meters.

The Ismailia canal hydraulic section along the area of interest at the present condition and after the enlargement pro-

undwater near Ismailia canal due to either the effect of sewage bonds or wastes from industrial establishments; iii) Evaluating the discharges that can be safely pumped from the wells using available data; and iv) Performing a technical and economical discussion for the feasibility of feeding El-Obour City using groundwater scheme from the well system nearby Ismailia Canal.

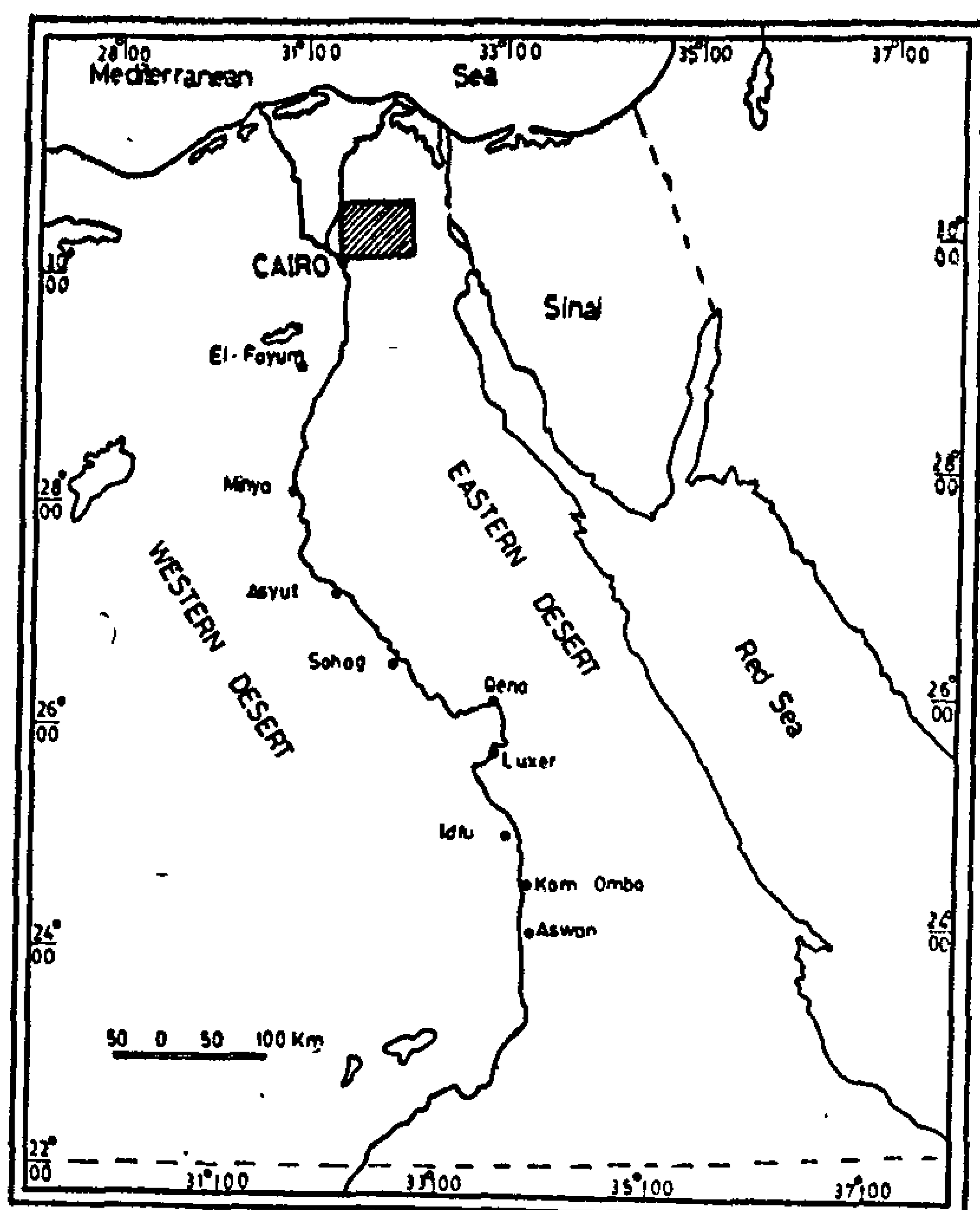


Fig. (1) Location of The Regional Study Area

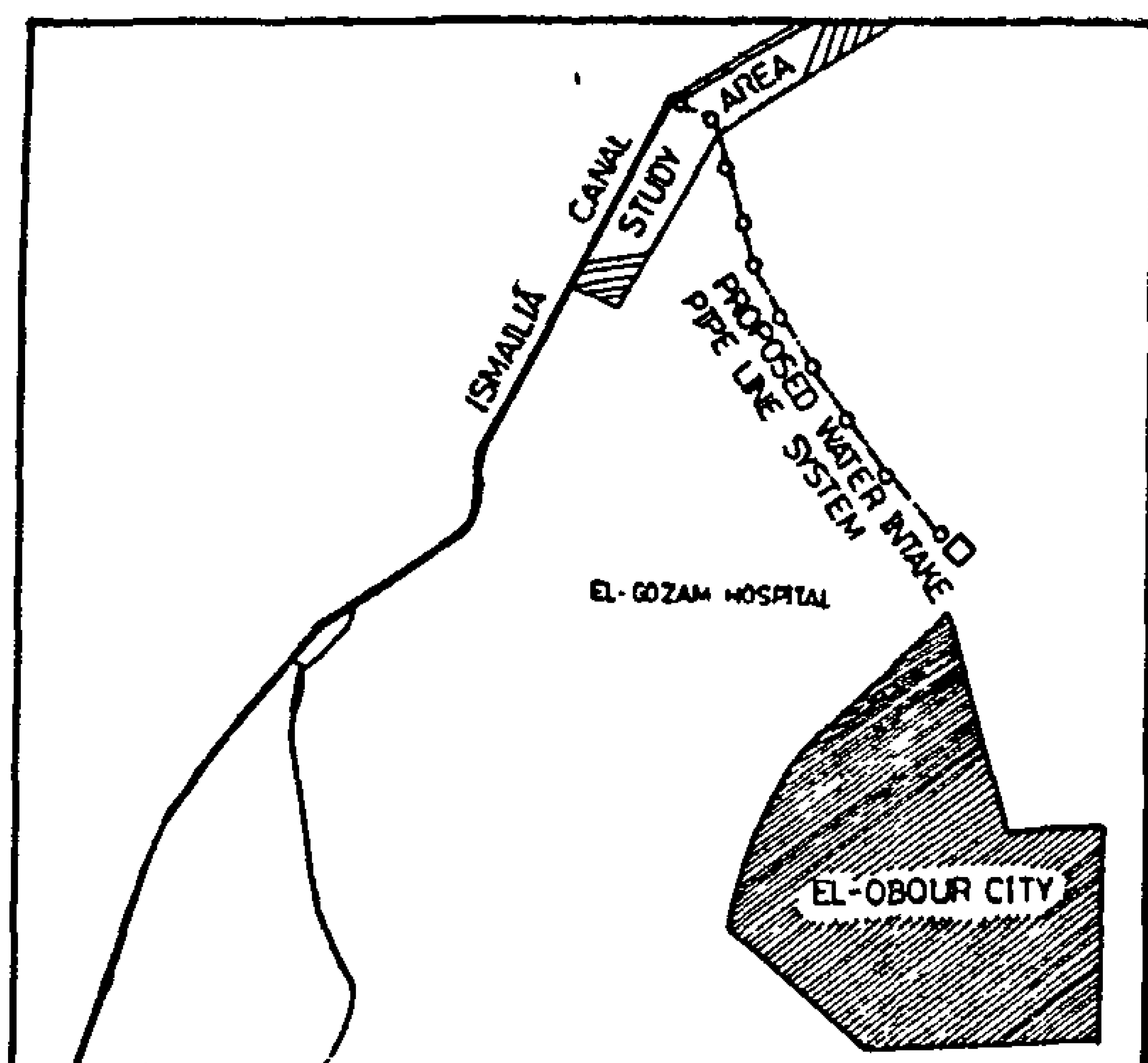


Fig. (2) A Map Illustrating The Location of El-Obour City, Ismailia Canal, The Route of Proposed Water Intake System and Study Area.

2. LOCATION OF THE REGIONAL STUDY AREA:

The area of the present investigation is regional rather than local it lies between Longitudes 31° 20' and 32°00' E and Latitudes 30°00' and 30° 30' N, respectively, Fig. (1). It covers an area of about 3600 km^2 and bounded by the Ismailia Canal along its Northwestern borders.

3. WATER DEMAND OF EL-OBOUR CITY:

The most promising source of water for El-Obour City is the Ismailia canal because the groundwater is very deep and saline [3]. Therefore, it is required to expand the capacity of the Ismaiiia canal in order to fulfill the water demand of El-Obour City. This demand has been estimated in the Master Plan Study of El-Obour City (1983) as follows [4], [5]:

Normal daily demand = 153,400 m^3
Maximum daily demand= 189,400 m^3

The daily demand which is determined by the Master Plan Study includes the consumptions of inhabitants, schools, hospitals, authorities, irrigation, and private small-scale establishments, besides the industrial requirements. Furthermore, the water losses as a result of distributing the potable water have also been included. It has been recommended that three mins pumping are to be installed to transmit the maximum daily demand from the Ismailia canal to El-Obour City. The Ministry of Irrigation has recently approved the increase of the discharge of the Ismailia canal by 260,00 m^3/day in order to meet the water requirements of El-Obour and El-Amel cities.

4. STUDY OF ISMAILIA CANAL (FROM Km 35-Km 45):

4.1. Present and Future Status of Ismailia Canal:

The Ismailia canal is amajor irrigation and inalnd navigation canal for the east and southeast areas of the Nile Delta.

INFILTRATED WATER POTENTIALITY FROM ISMAILIA CANAL AS A SOURCE OF WATER SUPPLY FOR EL-OBOUR CITY

Dr. Reda M. El-Damak* and Dr. Ismail I. El-Hemary*

1. INTRODUCTION

The economics growth coupled with population pressure invitably in Egypt caused a great demand for the construction of new cities and settlements In the last two decades, about ten developed cities have been constructed in Egypt. The groundwater is considered the most preferred water supply in the majority of the new Egyptian developed cities. Groundwater in most situation is characterized by tolerable salinity and less bacteriological contamination than surface water sources. El-Obour City is one of the new Egyptian developed cities. The El-Obour City is located at Cairo-Ismailia desert in the neighbourhood of Ismailia Canal. Fig. (1).

El-Obour City will have a final population of 240,000 by the year 2005. Water demand for the city are mainly directed towards domestic consumption potable water for irrigation and industrial water uses. One of the promising sources of water is from Ismailia Canal either by direct intake station or by constructing a system of wells nearby the canal to obtain more filtrated water. Previous experiments have fortunately indicated that the Ismailia Canal is no polluted by its neighbouring establishments [4].

Groundwater resources at Cairo-Ismailia desert road, Orabi area, and El-Obour region are not suitable for domestic purposes due to the high level in salinity contents (4000-16000 ppm) and ionic concentrations are more than permissible limits [2], [3]. It is possible to use such water after destillation or mixing with fresh water. A process, however, could be economically unattractive.

The Ministry of Irrigation has approved an amount of 260,000 m^3/day from Ismailia Canal for feeding both El-Obour and Badr Cities. This amount is proposed to be pumped directly through water intake at Km 35 on Ismailia Canal, See Fig. (2). Another alternative is to replace this water intake by system of wells nearby Ismailia Canal. Water collected from these wells are then pumped to the above cities. It may be postulated that invoking this bank wells system, water obtained through seepage is more filtrated and requires simpler water treatment compared to that pumped directly from the canal [6].

The objective of this study is to carry out a technical investigation for constructing a system of wells nearby Ismailia canal for feeding El-Obour city by its water demands. The study is concentrated on the canal stretch extending from Km 35 to Km 45, Fig. (2). This stretch is chosen because it is the only evacuated zone along the Ismailia Canal. Besides, it may be considered as the nearest zone along the Ismailia Canal to the El-Obour City. This study can be outlined as follows: i) Studying the present and future carrying capacity of the Ismailia canal; ii) Studying possible sources of contamination to gro-

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tinuous beams, requires major modification and further research. Also. it has to be emphasized that, in the present formulation, no explicit deflection constraint is included. The effect of deflection requirements on the optimum design requires further research.

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6-1.5. Optimal Steel Strength

In all the applications considered, shear reinforcement was always taken from steel with f_y=2800 kg/cm² while longitudinal reinforcement was taken once with f_y-2800 kg/cm² and once with f_v =4200 kg/cm². With the assumed prices, which are given in section 6-1, it was found that using steel with f_y=4200 kg/cm² results in savings which vary between 11% for beams with relatively light loads and 6% for beams with relatively heavy loads.

6-2. Effect of Relative Price Changes

To study the effect of relative changes of the prices of concrete and steel, a number of problems were solved with different spans, loads and concrete strengths. The prices C_c of concrete were taken as given in Section 6-1. Steel with f_y=2800 kg/cm² was used. The prices C_{s1} and C_{s2} of the steel were taken equal to a unified price C_s. To allow for variation of the ratio C_s / C_c different values of (100,200,350,500 and 700 L.E. L.E./ton) were assumed for C_s .

Within the considered range of variation of C_s/C_c the use of compression reinforcement was always uneconomical, i.e. p_1 opt=0.

Figure 7 shows the typical variation of d_{opt}, P_{opt} and $A_{v\,opt}$ with C_s/C_c. It can be seen that d_{opt}, P_{opr} P_{pot} and A_{vopt} vary considerably as C_s/C_c changes. Therefore, it has to be emphasized that to use the approximate equation (26) for d_{opt} values of K_d have to be evaluated for the actual values of C_s/C_c at the time of any specific application.

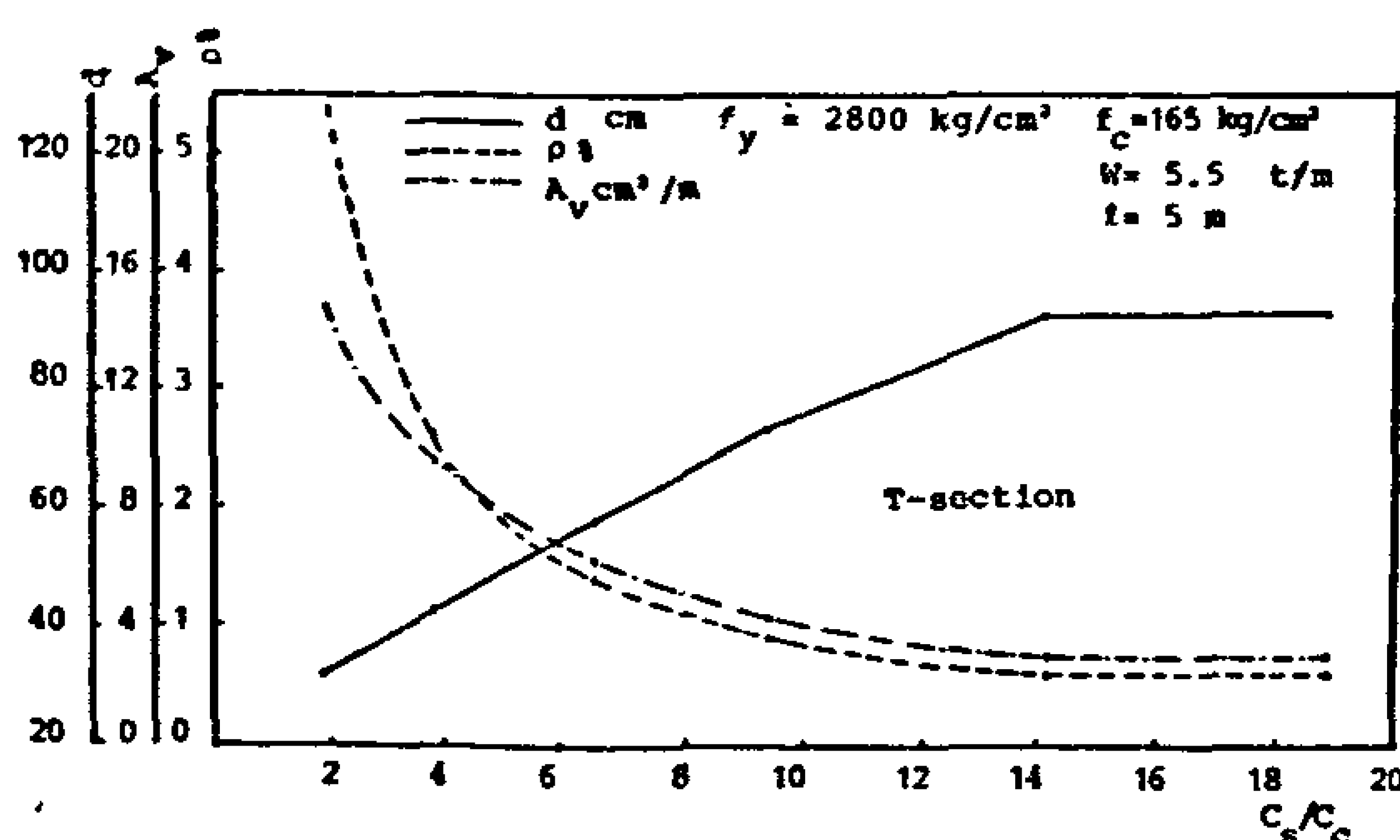


Fig. 7: Variation of d_{opt}, ρ_{opt} and A_{vopt} with C_s/C_c.

For derivation of values of k_d for different prices, the program referred to in section 5 and the least squares curve fitting method may be used.

7. Conclusion

A formulation has been presented for the minimum cost design of simply supported rectangular and T reinforced concrete beams subjected to uniformly distributed loads.

In the present formulation, the cost includes both the prices of materials and the cost of labour. The constraints include strength in bending, strength in shear, ductility and direct limits on the width, depth and steel ratios.

Reference has been made to a computer program which uses the sequential unconstrained minimization technique, SUMT, for determining the optimal variables.

Application of the proram has lead to useful observtions on the optimum design. The optimum width is the least feasible width. On the basis of the results and using least squares curve fitting, an expression has been found for the optimum depth which was found to be approximately proportional to the product of the square roots of the span and the design load. The use of compression reinforcement was found to be uneconomical even when the ratio between the prices of the steel and concrete becomes as low as about 2 (the currently prevailing ratio is about 7).

With no compression reinforcement and with a given approximate optimum depth, areas of the tension and shear reinforcement can be directly determined.

The present formulation requires only minor modifictions to apply to simple cantilevers and different loads (only equations 3 and 12 have to be modified to apply to the relevant system and loads). Generalization to nonprismatic beams and to beams with more than one critical section in bending and shear, such as con-

differentiation between singly and doubly reinforced sections. The use of $p_1 \mp 0$ would, of course, reduce the depth but with the assumed prices this was found to be uneconomical.

The complete set of values of ρ_{opt} and $A_{v\,opt}$ is not given in this paper due to space limitations. However, with a known value of d_{pot} (from equation 26), and with $p_{1\,opt} = 0$, values of ρ_{opt} and $A_{v\,opt}$ can be determined directly from the flexural and shear strength constraints. Yet, values of p_{opt} and $A_{v\,opt}$ are plotted in Figures 4 and 5 to show the variation of these optimal values with different design parameters.

Figure 4 shows that, rather surprisingly p_{opt} decreases as the load W increases. On the other hand, p_{opt} as expected, increases as f_c increases (since increasing f_c results generally in a smaller d_{opt} Also, as expected, p_{opt} decreases as f_y increases. The variation of p_{opt} with the span is typically shown by Figure 5 from which it may be observed that p_{op} is neither considerably nor regularly affected by the span.

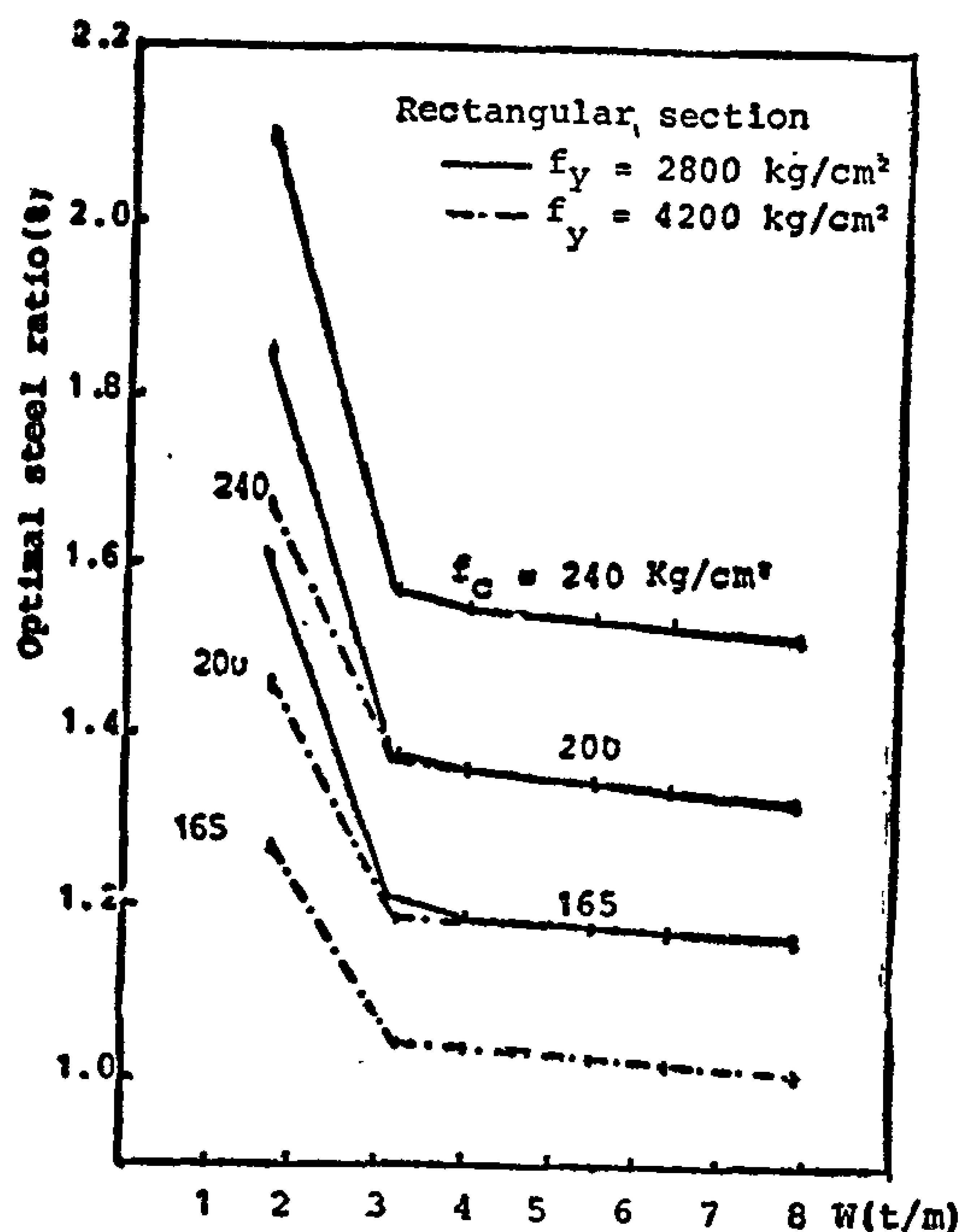


Fig. 4: Variation of ρ_{opt} with f_c, f_y and loads.

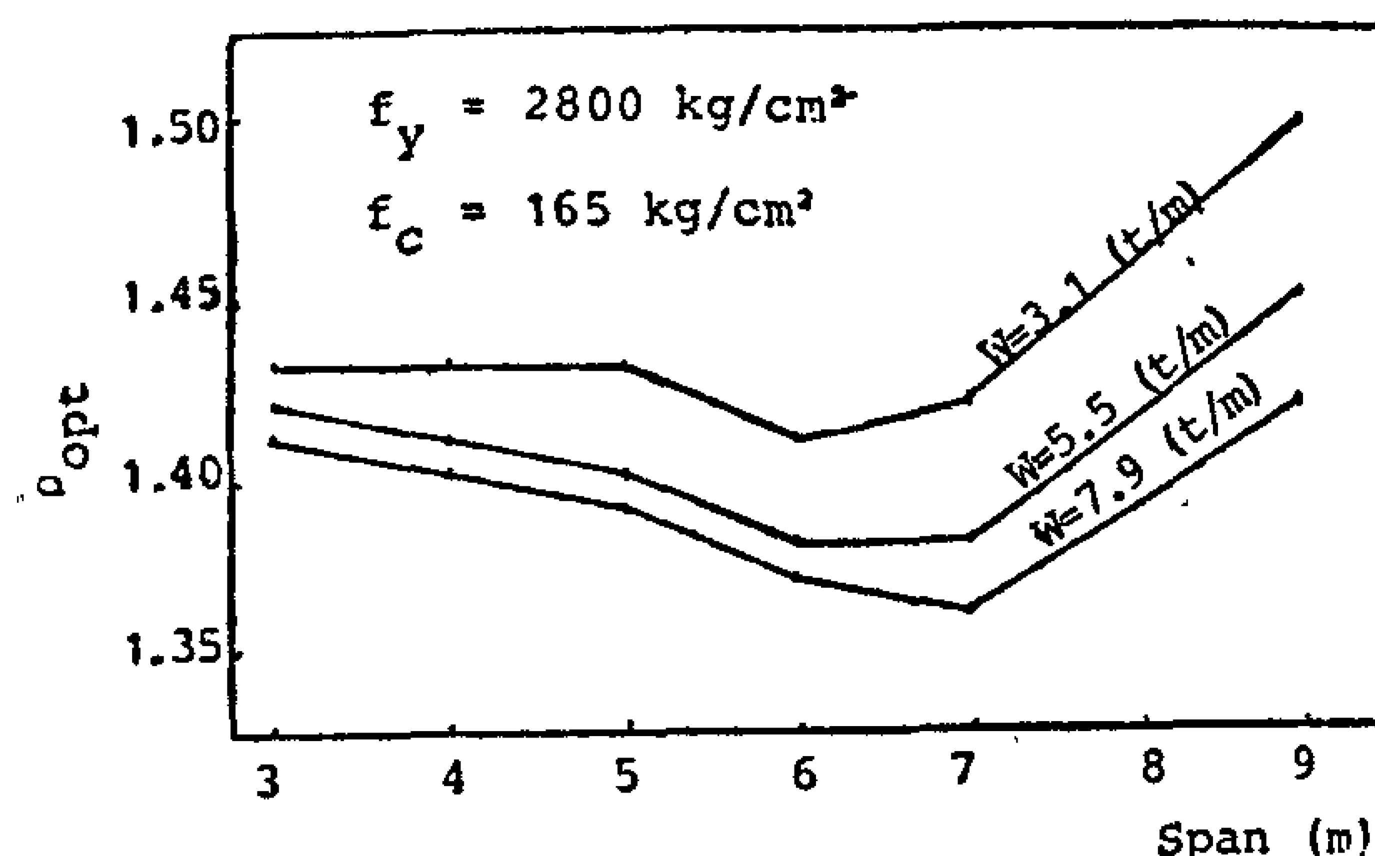


Fig. 5: Variation of ρ_{opt} with the span

Figure 6 shows the variation of $A_{v\,opt}$ with spans and loads. As Figure 6 shows, $A_{v\,opt}$ increases as W increases. Also, A_{opt} generally increases as the span increases except in cases of relatively light loads where $A_{v\,opt}$ may decrease as the span increases.

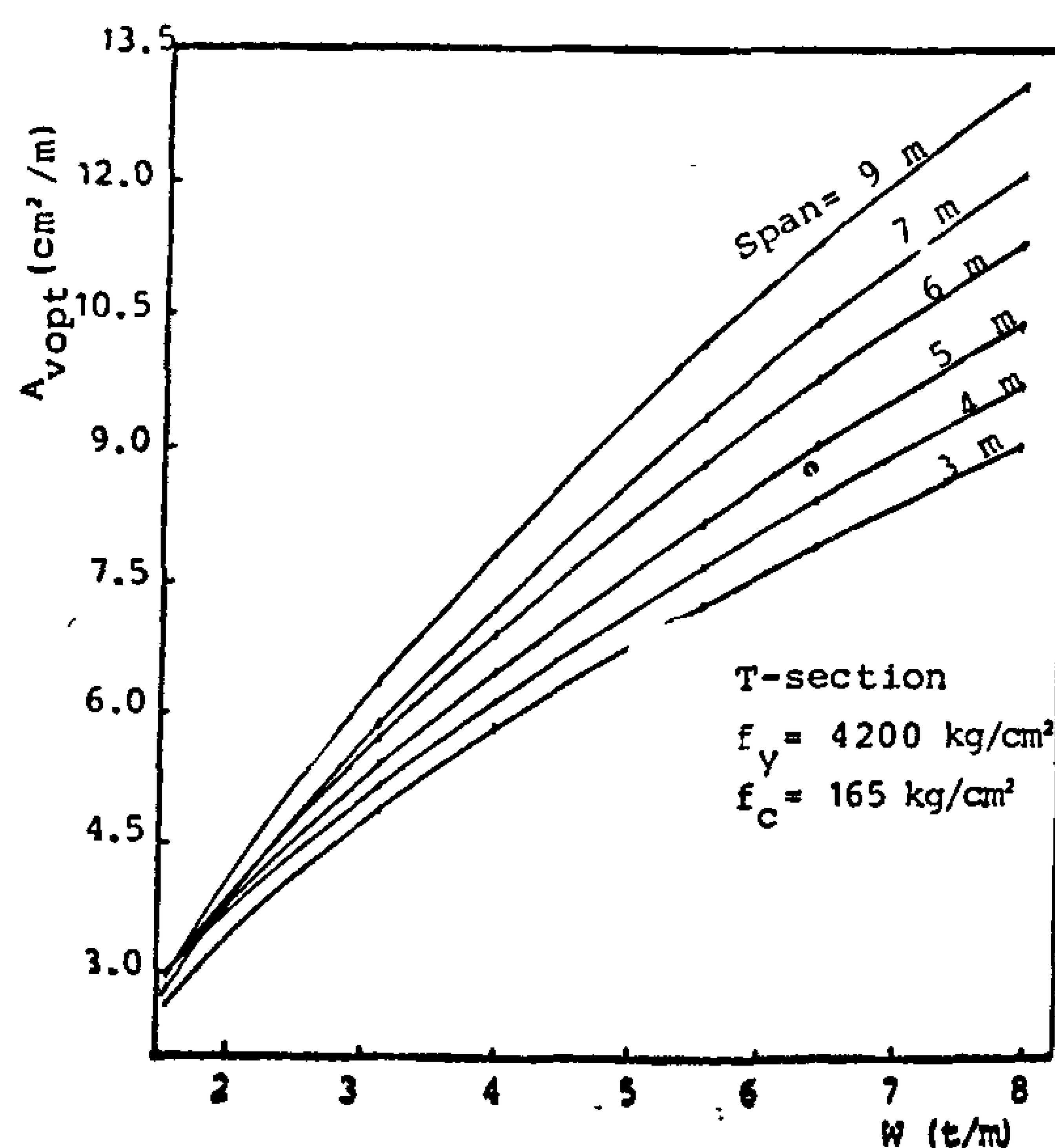


Fig. 6: Variation of $A_{v\,opt}$ with spans and loads.

6-1.4 Optimal Concrete Strength

With the assumed unit prices of 53,60 & 68 L.E./m3 for concrete with f_c =165,200 & 240 kg/cm2, respectively, it was found that concrete with lowest feasible strength is optimal. Beams made of concrete with f_c =240 kg/cm2 are about 10% more expensive than those made of concrete with f_c =165 kg/cm2.

Table (1): Curve Fitting Analysis for Approximate Optimal Depth

Section	f_y	f_c'	K_d	Δ_{26}	Δ_{27}	S_{26}	S_{27}
rect.-angular	2800	165	12.5643	4.48	4.25	126.86	121.83
		200	11.6757	4.35	4.05	109.26	101.72
		240	10.8382	4.10	3.84	100.84	95.58
	4200	165	11.2128	2.62	3.19	89.08	85.45
		200	10.3842	2.60	2.87	75.96	73.89
		240	9.6414	2.45	2.57	64.04	63.22
T	2800	165	10.9949	2.62	2.49	56.69	55.73
		200	10.2442	2.07	2.38	49.13	46.00
		240	9.5758	2.11	2.15	42.99	41.59
	4200	165	9.1691	2.03	1.97	45.21	43.14
		200	8.6465	2.19	2.13	39.01	38.48
		240	8.1104	2.51	2.47	38.57	37.93

Δ_{26} = maximum absolute deviation (in centimetres) of d_{opt} on the basis of equation 26 from d_{opt} obtained using the program.

Δ_{27} = similar deviation on the basis of equation 27 (with $a_1 = a_2 = 0.5$ which gave particularly good fits)

S_{26} = sum of the squares of the deviations (Δ_{26}).

S_{27} = sum of the squares of the deviations (Δ_{27}).

Values of K_d, Δ_{26}, Δ_{27}, and S_{27} in Table 1 are based on 36 values of d opt which correspond to combinations of l = 3,4,5,6,7 and 9 m and W = 1.55, 3.1, 3.95, 5.5, 6.35 and 7.9 t/m.

values of d_{opt} obtained using equation 26 are plotted in Fig. 3 for comparison with original values of d_{opt} Fig. 3 and Table 1 show that equation 26 produces values for d_{opt} which differ only slightly from the actual optimal depth. The effect of this difference on the optimum cost has been found to be almost negligible.

From equation (26), it can be seen that the common practice of choosing the depth only on the basis of the span (e.g. 1/10 of the span) is, in general, not optimal.

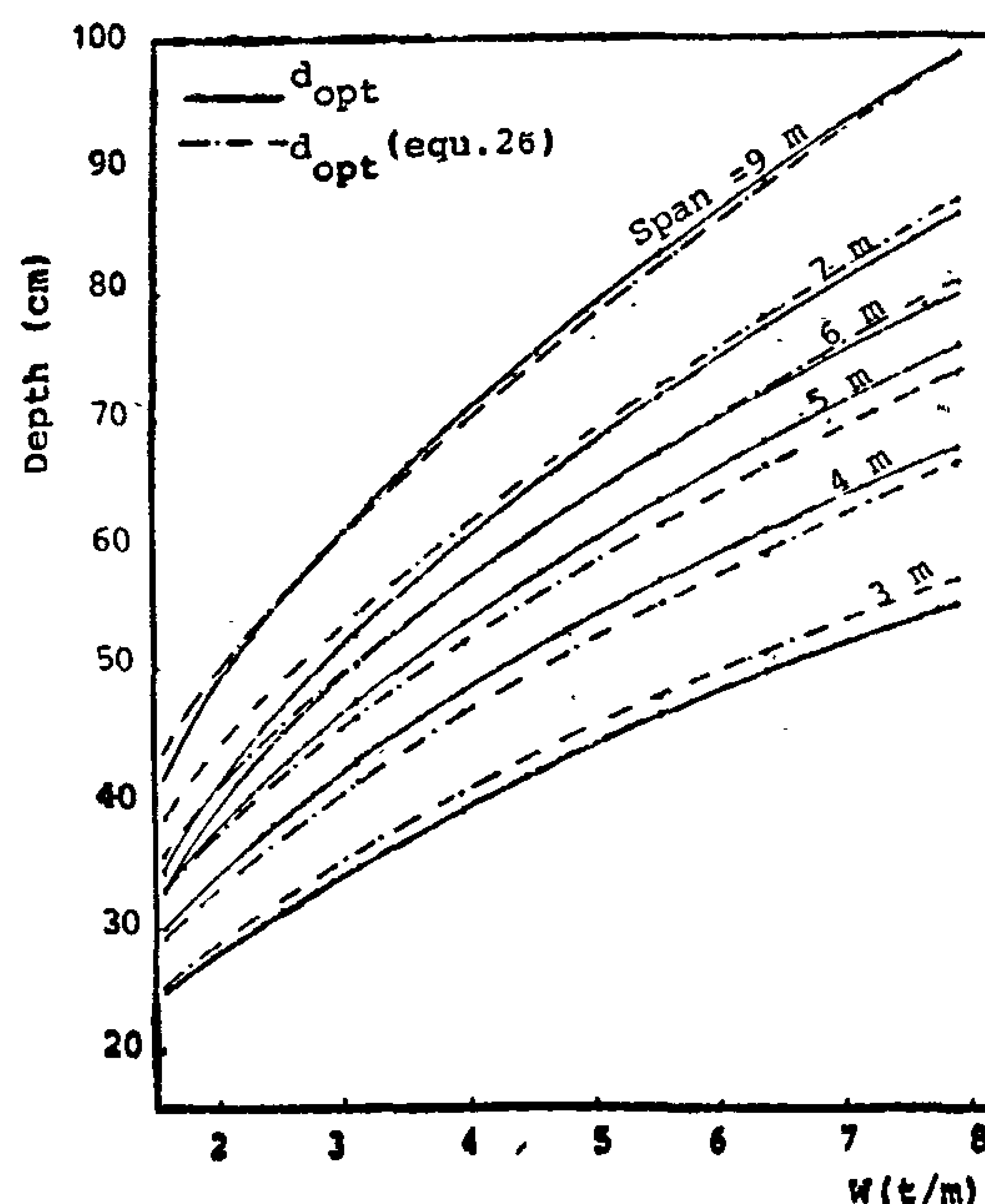


Fig. 3: Variation of Optimal Depth with Spans and Loads.

6-1.3. Optimal Reinforcement

In all the cases considered, it was economical to use no compression reinforcement, i.e. $p_{1\ opt} = 0$. Thus, the results for doubly reinforced sections were identical with those for singly reinforced sections. This is why the values of $_d$ in Table 1 are given for rectangular sections without

Before summarizing the results, it is worth mentioning that the program and the method SUMT performed satisfactorily in solving Programs I,II and III. This is fortunate and could not be predicted without actual experimentation since the constraints do not saisfy all the usual theoretical requirements. For example, nothing can be said about the continuity of the derivatives of inequalities 2 and 14 in Programs II and III as they are defined by different expressions over different ranges as summarized in sections (4-5-2) and (4-5-3).

Important observations on the optimum design, on the basis of the results, are given in the following sections.

6-1.1. Optimal Width

Mininum widths of 10,12,15,20,25 and 30 cm were specified for beams of spans of 3,4,5,6,7 and 9 m, respectively. These minimum widths were always found to be optimal. The effect of varying the minimum width on the optimum cost of a beam is shown in Fig. 2. From that figure, it can be seen that reducing the width results in considerable reduction of the cost.

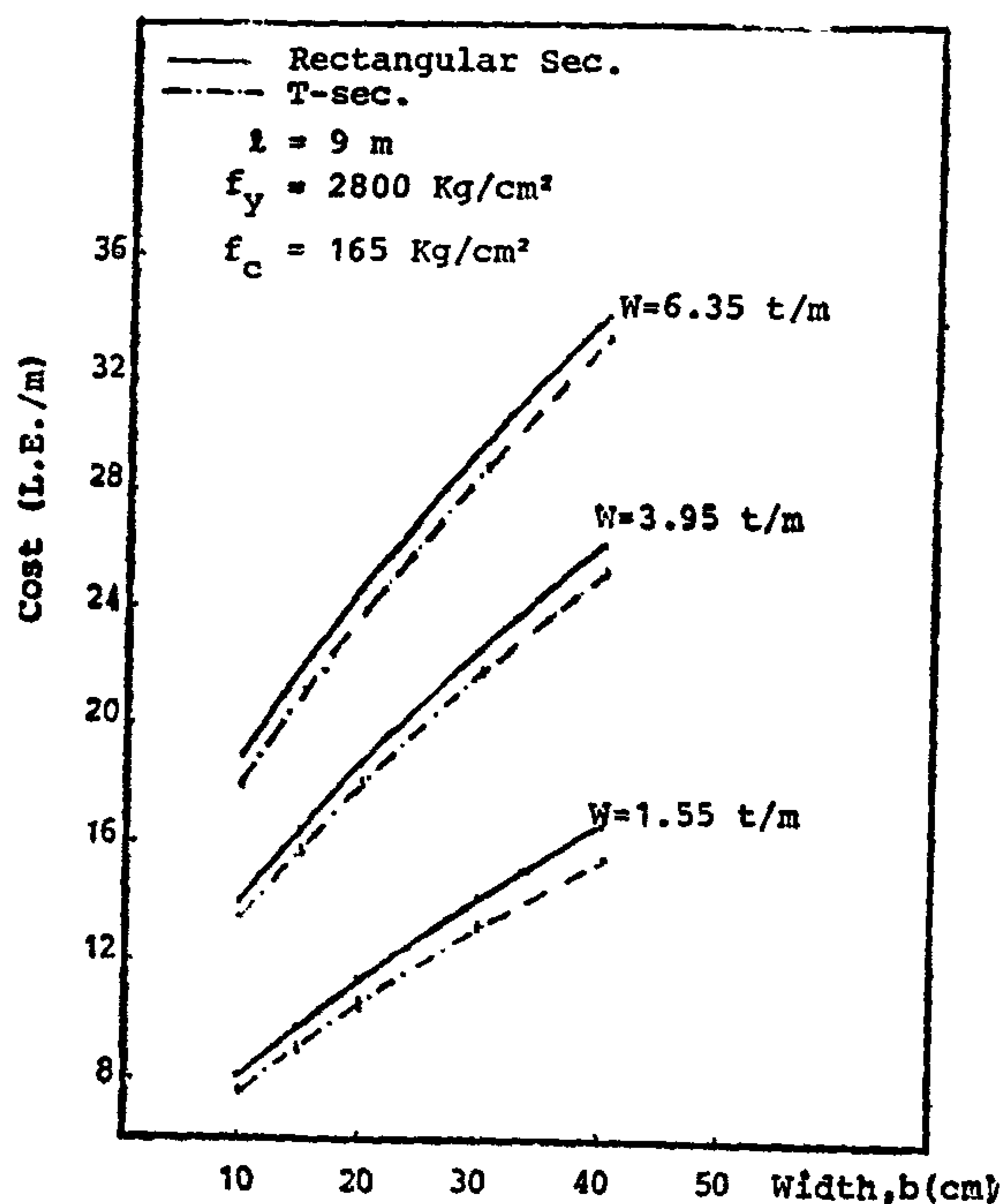


Fig. 2 : Effect of width on optimum cost.

Reducing the width may create some practical problems and result in violation of some constraints which are not included in the present formulation such as lateral buckling. However, the considerable savings associated with reduction of the width indicate that research should be carried out to find out methods by means of which width reductions can become feasible and economical.

6-1.2. Optimal Depth

The typical variation of the optimal depth with the span, loads and material properties is shown in Fig. 3. From that figure it can be observed that a rather simple relation exists for the optimal depth d_{opt} in tems of the span (l) and the design load (W).

Using the classical least squares method for curve fitting, it has been found that a good approximation for d_{opt} is given by:

$$d_{opt} = K_d \sqrt{W\ell} \quad \ldots\ldots\ldots \quad (26)$$

where K_d is a coefficient which depends on the type of section and on the values of F_c and f_y . Values of K_d are given in Table 1.

To assess the goodness of the fit obtained from equation (26) different other functions were tried such as the complicated expression.

$$d_{opt} = k_o + K_1 W^{a_1} + K_2 \ell^{a_2} + K_3 W^{a_1} \ell^{a_2} \quad \ldots (27)$$

where a_1 and a_2 are different assumed coefficients and K_o, K_1, K_2 and K_3 are coefficients which are obtained using the least squares method. For comparison of the goodness of the fits obtained using the simple equation 26 and the complicated equation 27, the following values are listed in Table 1;

which corresponds to the least optimum cost, i.e. by exhaustive enumeration.

The optimum design (i.e. the optimum d,b, p, A_v and p_1) corresponding to given material properties is determined by using the nonlinear programming method SUMT for solving one of the following mathematical programs:

4-5.1. **Program I** (for singly reinforced rectangular sections).

Determine p,b,d and A_v to minimize the cost in equation 1 subject to the following constraints:

— inequality 2 (where M and M_u are defined by equations 3 and 4).

— inequality 11 (where v and v_u are defined by equations 12 and 13).

— inquality 14 (where p_b is defined by equation 15).

— inqualities 20,21,22,23, 24 and 25.

4-5.2 **Program II** (for doubly reinforced rectangular sections).

Determine p,b,d, A_v and p_1 to minimize the cost in equation 1 subject to the following constraints:—

— inequality 2 (where M is defined by equation 3 and M_u is defined by equaion 6 if inequality 5 is satisfied and by equation 7 otherwise).

— inequaltiy 11 (where v and v_u are defined by equations 12 and 13).

— inequality 14 (where p_b is defined by equation 16 if inequality 5 is satisfied and by equation 17 otherwise).

— inequalities 20,21,22,23,24 and 25.

4-5.3 **Program III** (for T-section)

Determine p,b,d and A_v to minimize the cost in equation 1 subject to the following constraints:

— inequality 2 (where M is defined by equation 3 and M_u is defined by equation 9 if inequality 8 is satisfied and by equation 10 otherwise).

— inequqlity 11 (where v and v_u are defined by equations 12 and 13).

— ineqiality 14 (where p_b is defined by equation 18 if inequality 8 is satisfied and by equation 19 otherwise).

— inequalities 20,21,22,23,24 and 25.

5. Computer Program

A FORTRAN program was prepared for solving the mathematical programs I,II and III using the method of SUMT. The program consists of a number of subroutines which were published by Kuester and Mize (1973) for performing the mathematical steps of SUMT plus some subroutines which describe the three programs I,II and III. Complete documentation of the program was presented by Kabil (1985). Given the span, the load, material properties, unit costs and type of section, the program produces the optimal dimensions (b and d), reinforcement (p and A_v and p_1 if present) and the optimum cost.

6. Applications and Results

6-1. Optimum Design at Current Prices

The computer program was used for the minimum cost design of a large number of beams covering combinations of the following design parameters:

—spans (l) from 3m to 9 m

— loads: superimposed factored load ($W = 1.4\ W_D + 1.7\ W_L$ from 1.5 t/m to 8 t/m.

— concrete strengths: f_c = 165, 200 or 240 kg/cm² with costs C_c = 53, 60 and 68, L.E./m³ respectively.

— steel yield stress:

f_y = 2800 kg/cm² with C_{s1} = 350 and C_{s2} = 360 L.E./ton

f_y = 4200 kg/cm² with C_{s1} = 400 L.E./ton.

Each beam was solved three times: with singly reinforced rectangular section, doubly reinforced rectangular section and T-section,

$$v_u = v_{cr} + 10^{-4} A_v f_y / b \text{ (kg/cm}^2\text{)} \quad \ldots\ldots\ldots\ldots (13)$$

where

$$v_{cr} = 0.0703[1.9(\sqrt{f_c}/0.0703) + 2500\rho d \left(\frac{span}{2}\right) / \left(\frac{span^2}{8}\right)] < 0.0703[3.5(\sqrt{f_c}/0.0703)] \text{ kg/cm}^2$$

4.3. Ductility

For ductile behaviour, it is required that the steel ratio ρ be no larger than 0.75 of the balanced steel ratio ρ_b at which failure occurs by simultaneous yielding of the tension steel and crushing of concrete, i.e.

$$0.75\,\rho_b - \rho \geq 0 \quad \ldots\ldots (14)$$

For singly reinforced sections:

$$\rho_b = 0.85\beta_1 (f_c/f_y) [6300/(6300+f_y)] \quad \ldots\ldots (15)$$

For doubly reinforced sections, the ex- as follows:

pression for ρ_b depends on inequality (5)

(i) If inequality (5) is satisfied, then

$$\rho_b = 0.85\beta_1 (f_c/f_y) [6300/(6300+f_y)] + \rho_1 \ldots (16)$$

(ii) If inequality (5) is not satisfied, then

$$\rho_b = 0.85\beta_1 (f_c/f_y) [6300/(6300+f_y)] + \rho_1 f_s/f_y \quad \ldots (17)$$

where f_s is the stress in the compression steel (as defined below equation 7).

For T-sections, the expression for ρ_b depends on inequality (8) as follows:

(i) If inequality (8) is satisfied, then

$$\rho_b = 0.85\beta_1 (f_c/f_y) [6300/(6300+f_y)] B_f/b \ldots (18)$$

(ii) If inequality (8) is not satisfied, then

$$\rho_b = 0.85\beta_1 (f_c/f_y) [6300/(6300+f_y)] + A_{sf}/bd \quad \ldots (19)$$

(where Asf is as defined below equation (10).

4-4. Direct Limits on Variables

Deflection control, fire resistance and other considerations impose a minimum limit d_{min} on the depth. Architectural, functional and other considerations impose a maximum limit d_{max} on the depth and minimum and maximu limits b_{min} and b_{max} on the width. Thus,

$$d - d_{min} \geq 0 \quad \ldots\ldots\ldots\ldots (20)$$

$$d_{max} - d \geq 0 \quad \ldots\ldots\ldots\ldots (21)$$

$$b - b_{min} \geq 0 \quad \ldots\ldots\ldots\ldots (22)$$

$$b_{max} - b \geq 0 \quad \ldots\ldots\ldots\ldots (23)$$

A minimum longitudinal steel ratio ρ_{min} and a minimum shear reinforcement area $A_{v\,min}$ are also specified. Thus,

$$\rho - \rho_{min} \geq 0 \quad \ldots\ldots\ldots\ldots (24)$$

$$A_v - A_{v\,min} \geq 0 \quad \ldots\ldots\ldots (25)$$

4-5. Summary of the Formulation and the Solution Procedure

The design variables are the discrete variables f_c and f_y and the continuous variables b,d, A_v and ρ (plus ρ_1 in the case of doubly reinforced sections).

The optimum values of f_c and f_y are obtained by determining the optimum design with each feasible combination of f_c and f_y and choosing the combination

$$M_u = \phi(10f_y)\rho bd^2 (1-0.59\rho f_y/f_c) \text{ m.t.} \ldots\ldots (4)$$

where $\phi = 0.9$

For doubly reinforced rectangular sections, the expression for M_u depends on the inequality:

$$\rho \geq 0.85\beta_1 (f_c/f_y)(d_1/d) [6300/(6300-f_y)] + \rho_1 \ldots\ldots (5)$$

where

$$\beta_1 = 0.85-(0.05/70)(f_c-280) < 0.85$$

(i) If inequality (5) is satisfied, then

$$M_u = \phi[\rho bd - \rho_1 bd)(10f_y)(d-\frac{a}{2}) + \rho_1 bd(10f_y)\ (d-d_1)] \ldots (6)$$

where

$$a = (\rho - \rho_1)\ f_y d/(0.85\ f_c)$$

d_1 = depth to compression steel

(ii) If inequality (5) is not satisfied, then

$$M_u = \phi[0.85(10f_c)ab(d-\frac{a}{2}) + \rho_1 bd(10f_s)(d-d_1)] \ldots\ldots (7)$$

where

$$f_s = \varepsilon_u E_s (c'-d_1)/c' \text{ (kg/cm}^2)$$

ε_u = ultimate strain in concrete

E_s = modulus of elasticity of the steel (kg/cm²)

and c' satisfies the equation

$$\rho bd\ f_y = 0.85 f_c \beta_1 bc' + \rho_1 bd\varepsilon_u\ E_s (c'-d_1)/c'$$

For T-sectons, the expression for M_u depends on the inequality:

$$h_f \geq \rho bdf_y/(0.85 f_c B_f) \ldots\ldots (8)$$

where h_f and B_f are the thickness and the effective width of the flange.

(i) If inequality (8) is satisfied, then

$$M_u = \phi[\rho(10f_y)bd (1-0.59\rho f_y b/(f_c B_f))] \ldots\ldots (9)$$

(ii) If inequality (8) is not satisfied, then

$$M_u = \phi[A_{sf}(10f_y)(d-h_f/2) + (\rho bd - A_{sf})(10f_y)(d-\frac{a}{2})] \ldots (10)$$

where

$$A_{sf} = 0.85 f_c (B_f - b) h_f/f_y$$

$$a = (\rho bd - A_{sf}) f_y/(0.85 f_c b)$$

4.2. Strength in Shear

The beam has adequate strength in shear if the shear stress (v) due to factored loads is not larger than the ultimate shear stress v_u, i.e.

$$v_u - v \geq 0 \ldots\ldots\ldots (11)$$

For a simply supported beam loaded with uniformly distributed dead load W_D and live load W_L, the shear stress v is given by

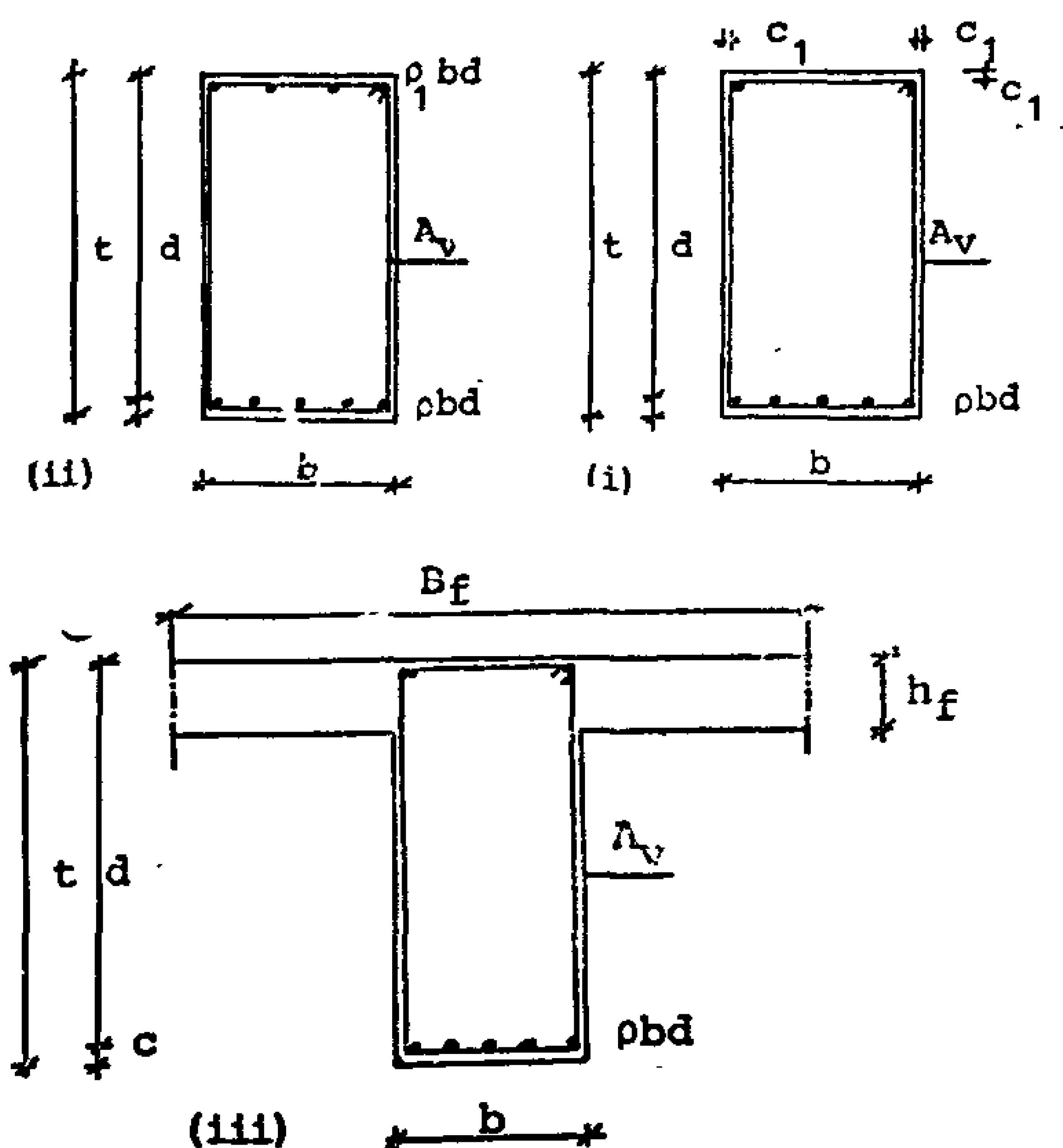
$$v = \frac{\text{span}}{2}[W+1.4\gamma_c b(d+c)] /(10\rho bd) \ldots\ldots\ldots\ldots\ldots (12)$$

where

$$w = 1.4W_D + 1.7\ W_L$$

$$\phi = 0.85$$

The ultimate shear stress is



(i) : Singly reinforced rectangular
(ii) : Doubly reinforced rectangular
(iii) : T-section

Fig. 1: Beam Sections

Only a limited number of choices of f_c and f_y are usually available. therefore, f_c and f_y are considered to be discrete variables. The variables b,d ρ, A_v and ρ_1 are considered to be continuous variables.

3. Cost

The cost of a segment of unit length of the beam is:

$$Cost = C_c b(d+c) + C_{s1}\gamma_s \rho bd + 10^{-4} C_{s2} A_v \gamma_s [2(b-2c_1) + 2(d+c-2c_1)] + C_{s1}\gamma_s \rho_1 bd \quad \ldots\ldots\ldots\ldots (1)$$

where

c = the distance from the centre of the tension steel to the adjacent side of the section (m),

c_1 = the distance from the centre of the stirrup to the adjacent side of the section (m),

c_c = total price of concrete per unit volume (L.E./m³) including the costs of materials plus the costs of forming, laying of the steel and pouring of the concrete. The price Cc varies with the strength fc of concrete

C_{s1} = price of longitudinal steel per unit weight L.E./ton.

C_{s2} = price of the steel used as stirrups per unit weight (L.E./ton). This price may be different from C_{s1} since the thinner bars used as stirrups are usually more expensive than other bars used for longitudinal reinforcement.

γ_s = density of the steel (ton/m³).

In the cases of singly reinforced sections and T-sections the term containing ρ_1 in the cost equation (1) is discarded.

4. Design Requirements (Constraints)

The constraints included in this formulation are strength in bending, strength in shear, ductility and direct limits on variables. Strength and ductility constraints are formulated on the basis of the ACI (1983) code and standard books on reinforced concrete design [for example, E.G. Nawy (1985)].

4.1. Strength in Bending

The ultimate strength in bending (M_u) should be at least equal to the design bending moment (M) due to design loads. This can be written as

$$M_u - M \geq 0 \quad \ldots\ldots\ldots\ldots\ldots (2)$$

The design moment M depends on the magnitude and distribution of loads. For a simply supported beam loaded with a uniformly distributed dead load W_D t/m and live load W_L t/m, the design moment is

$$M = \frac{(span)^2}{8} [W + 1.4\gamma_c b(d+c)] \quad \ldots\ldots\ldots (3)$$

where

$W = 1.4\ W_D + 1.7\ W_L$

γ_c = unit weight of concrete

For singly reinforced rectangular sections, the ultimate strength is:

OPTIMUM SIMPLE REINFORCED CONCRETE BEAMS

Amir Bayoumy Khalil (1) and Mohamed Kabil (2)

1. Introduction

Optimization of the design of a reinforced concrete building as a whole is a complicated problem which requires lengthy computations and extensive use of computers as shown, for example, by Hill (1966), Lamont (1972) and Skelton (1972). Therefore, some research has been directed towards the optimum design of separate elements, namely slabs, beams, columns and foundations. Simple methods for the minimum cost design of reinforced and prestressed concrete slabs were presented by Khalil (1977) and Loov and Khalil (1979). Studies on the optimum design of beams were presented by Spunt (1971), Skelton (1972), Timleck (1972), Salinas (1974) and Freil (1974). These procedures were based on different mathematical methods. Timleck (1972) used direct differentiation; Friel (1974) used Lagrangian multipliers; Salinas (1974) used the method of geometric programming. Those procedures, however, were either complicated or excluded some important cost items or constraints.

A research project [Khalil (1984)] was devoted to the study of the separate optimization of beams, columns and footings. The optimization of beams was also considered in an M.Sc. thesis by Kabil (1985). In the above mentioned project and thesis, the problem of the minimum cost design of simply supported reinforced concrete beams of constant sections was formulated as a nonlinear programming problem. The problem was solved using the sequential unconstrained minimization technique, SUMT, which was developed by Fiacco and McCormick (1968). In this paper, this formulation is summarized. Beasides, the results obtained earlier are used as a basis for simple approximate optimum design equations.

2. Design Variables

Three types of cross sections are considered: singly reinforced rectangular sections, doubly reinforced rectangular sections and T-sections (Fig. 1):

Design variables are

b = width (m),

d = depth from extreme compression fibre to the centre of tension steel (m),

p = ratio of tension steel = area of tension steel/(bd),

A_v = area of shear reinforcement on one side of the beam per unit length of the beam (cm²/m),

f_c = compressive strength of concrete (kg/cm²), and

f_y = yield stress of the steel (kg/cm²).

In the case of doubly reinforced sections an additional variable is considered:

p_1 = ratio of compression reinforcement.

= area of compression reinforcement / (bd).

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CONCLUSIONS

The effect of errection of a new building on the straining actions of the skeleton of an existing building have been theoritically investigated in this work taking into consideration the soil structure interaction. The following main conclusion are reached;

1 — The relative settlement between columns of the frame building, caused by the neighbour load, casuses a decrease in the loads of the outer columns and a corresponding increase in the loads of the inner columns. These additional column loads are maximum for the columns of the first floor and decrease gradually for the columns of upper storeys.

2 — Maximum induced moments in the columns and the beams of the super-structure takes place at the first floor level. The induced moments decrease in the upper storeys.

3 — The straining actions in the skeleton of the existing building, caused by the neighbour load, decrease with the increase of the soil stiffness and the raft foundadation thickness.

4 — The increase of the neighbour load distance (x) decreases the corresponding induced straining actions in the existing building structural elements. It was found that for load distance greater than 6.0m the straining actions induced in the building skeleton are of relatively small values.

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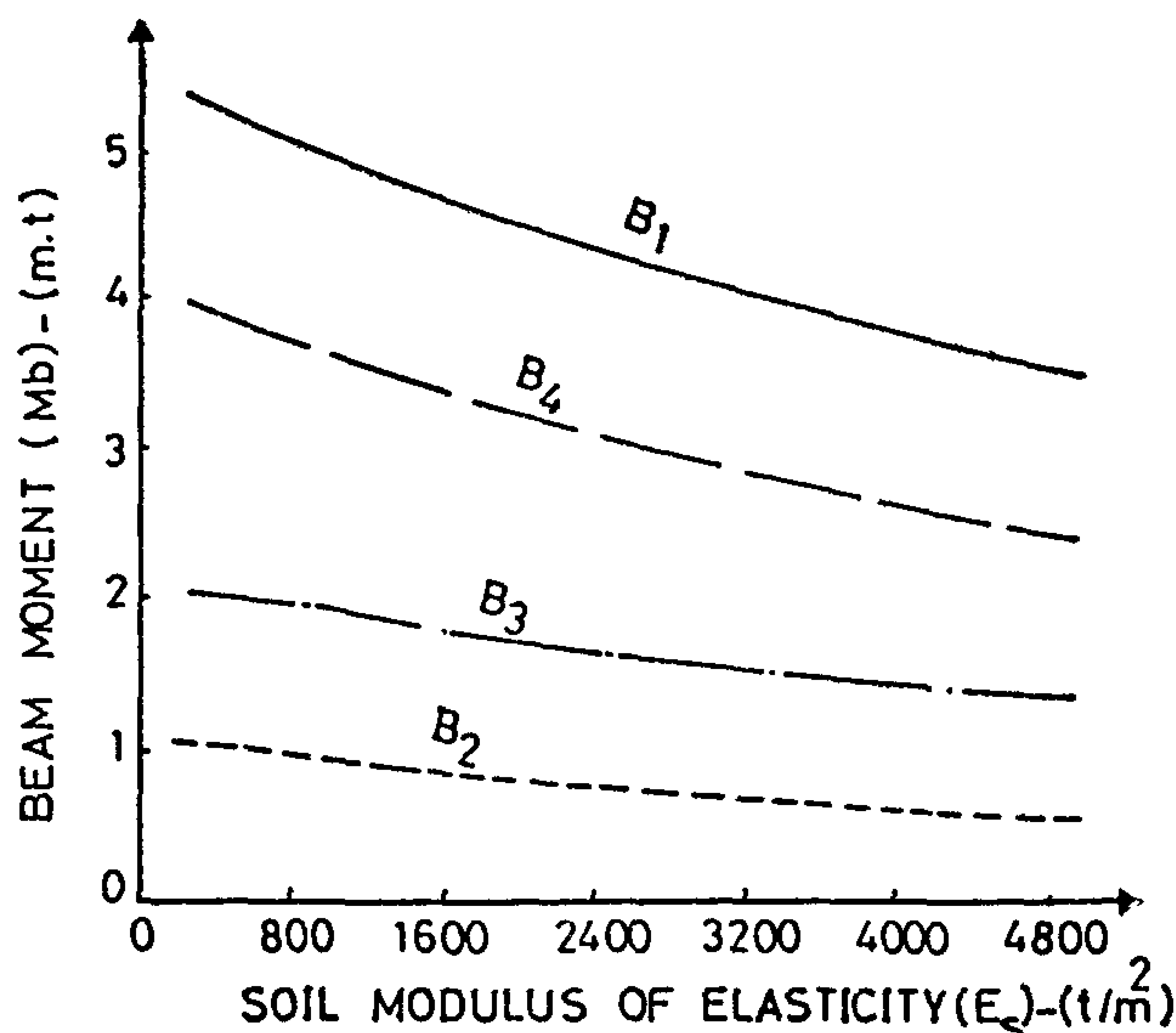


Fig. (21) Effect of the soil modulus of elasticity (Es) on the max. bending moments induced in the beams of the first floor.

3 — Effect of The Neighbour Load Distance

Figure (22) shows the relation between the maximum values of the end moments induced in the beam B1 of the super-structure and the storey number due to the presence of the neighbour load at different distances from the edge of the existing building foundaton. The presented curves indicate that the values of the end moments induced in the beams of the super-structure is very high in the case where the neighbour load is very close to the building frame i.e. the neibhhour load distance (X) is equal to 1.0m from the edge of the existing building foundation. These moments decrease rapidly as the neighbour load distance increases.

The effect of the neighbour load distance on the maximum end moments induced in the beams of the first floor is shown in figure (23). The curves given in this figure indicate that the values of the beam moments decrease rapidly with the increase of the neighbour load distance from 1.0m uo to a distance of 6.0m. Increasing the load distance more than 6.0m the beam moments decrease with a lower rate as the load distance increases. Referring to the same figure it is shown that the end moments induced in the beams of the first floor decrease by about 59.8%, 47.7%, 58.8% and 68.8% and 68.4% for beams B1 to B4 respectively with the increase of the neighbour load distance from 1.0m up to distance of 6.0m.

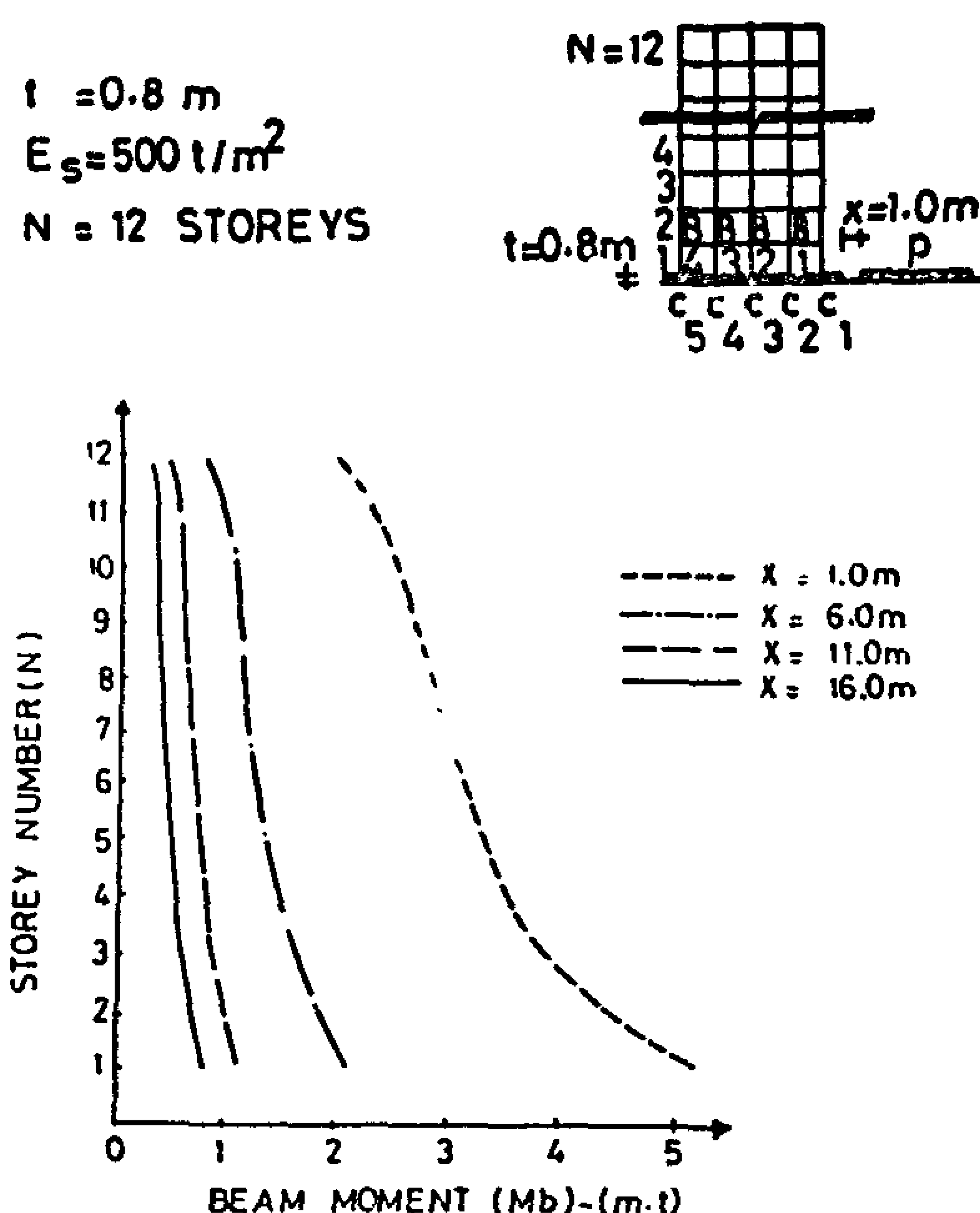


Fig. (22) Max. bending moment induced in beam (B1) for different load distance (X).

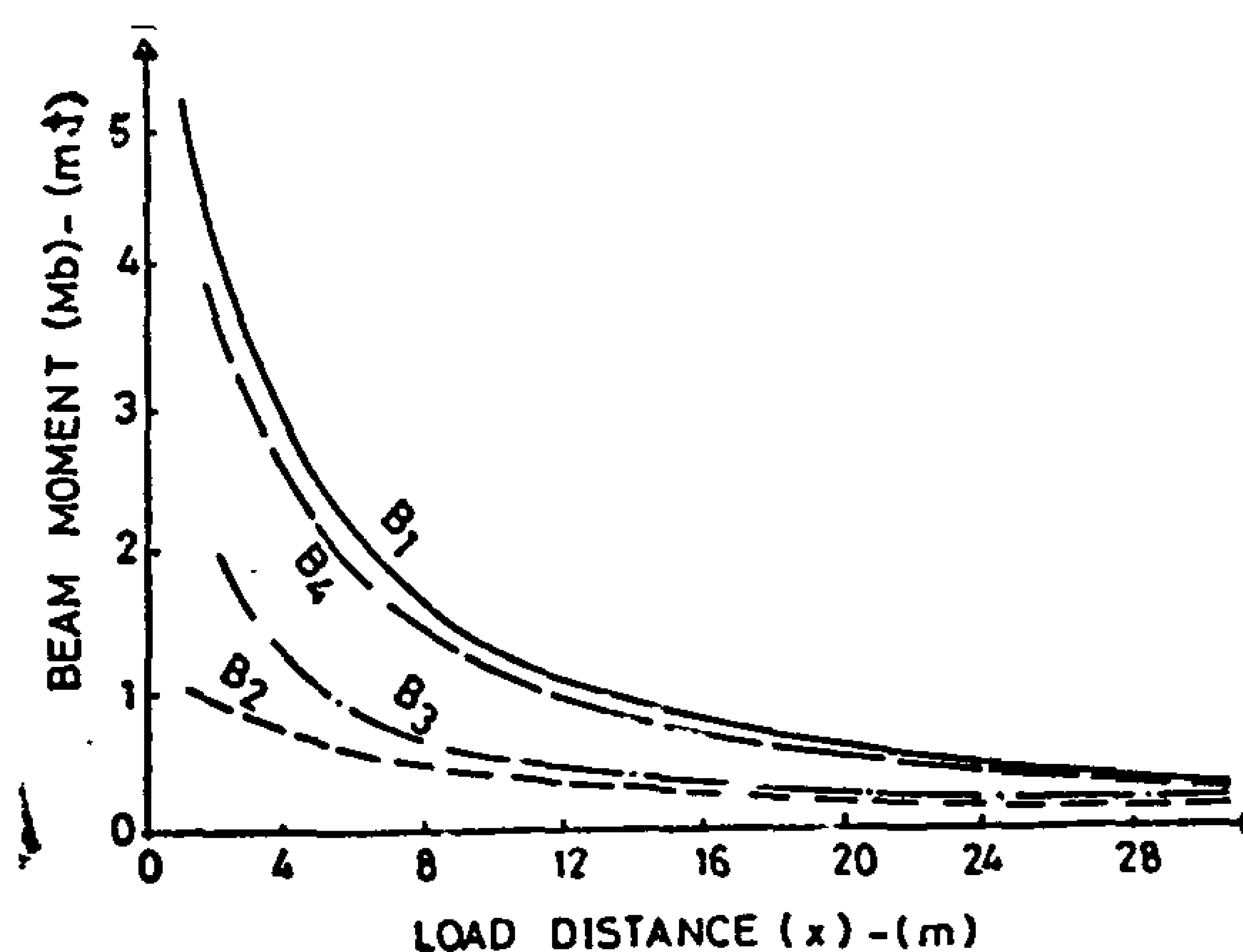


Fig. (23) Effect of the load distance (X) on the max. bending moments induced in the beams of the first floor.

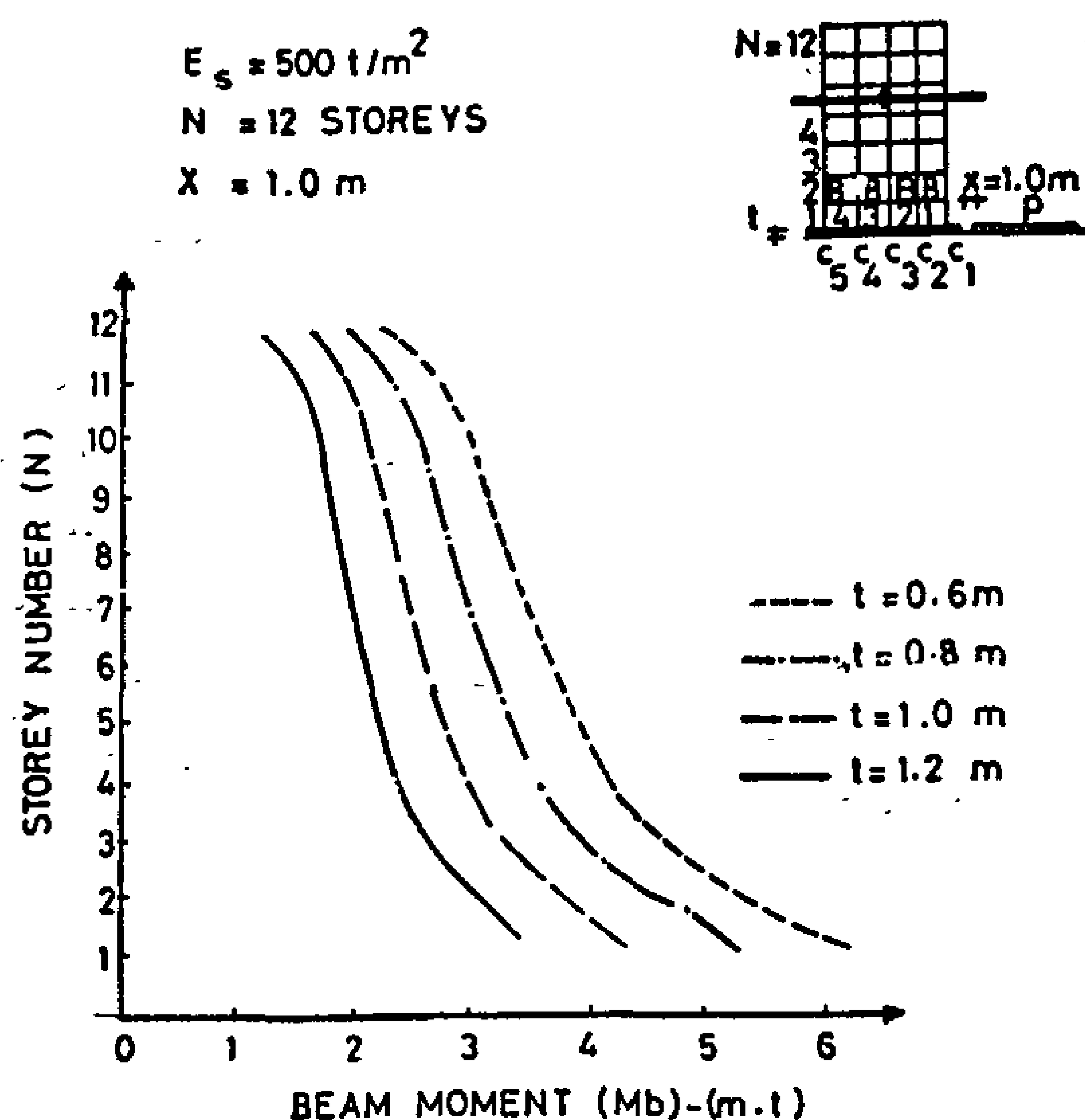


Fig. (18) Max bending moments induced in beam (B1) for different foundation thickness (t).

The effect of the foundation thickness on the maximum moments induced in the beams of the first floor is shown infigure (19). This figure shows that increasing the raft foundation thickness from 0.6m to 1.2m a decrease of about 43.8% 27.7% and 35.7% is recorded for the beams B1, B3 and B4 respectively while the mements induced in the beam B2 is almost unaffected with the increase of the foundation thickness.

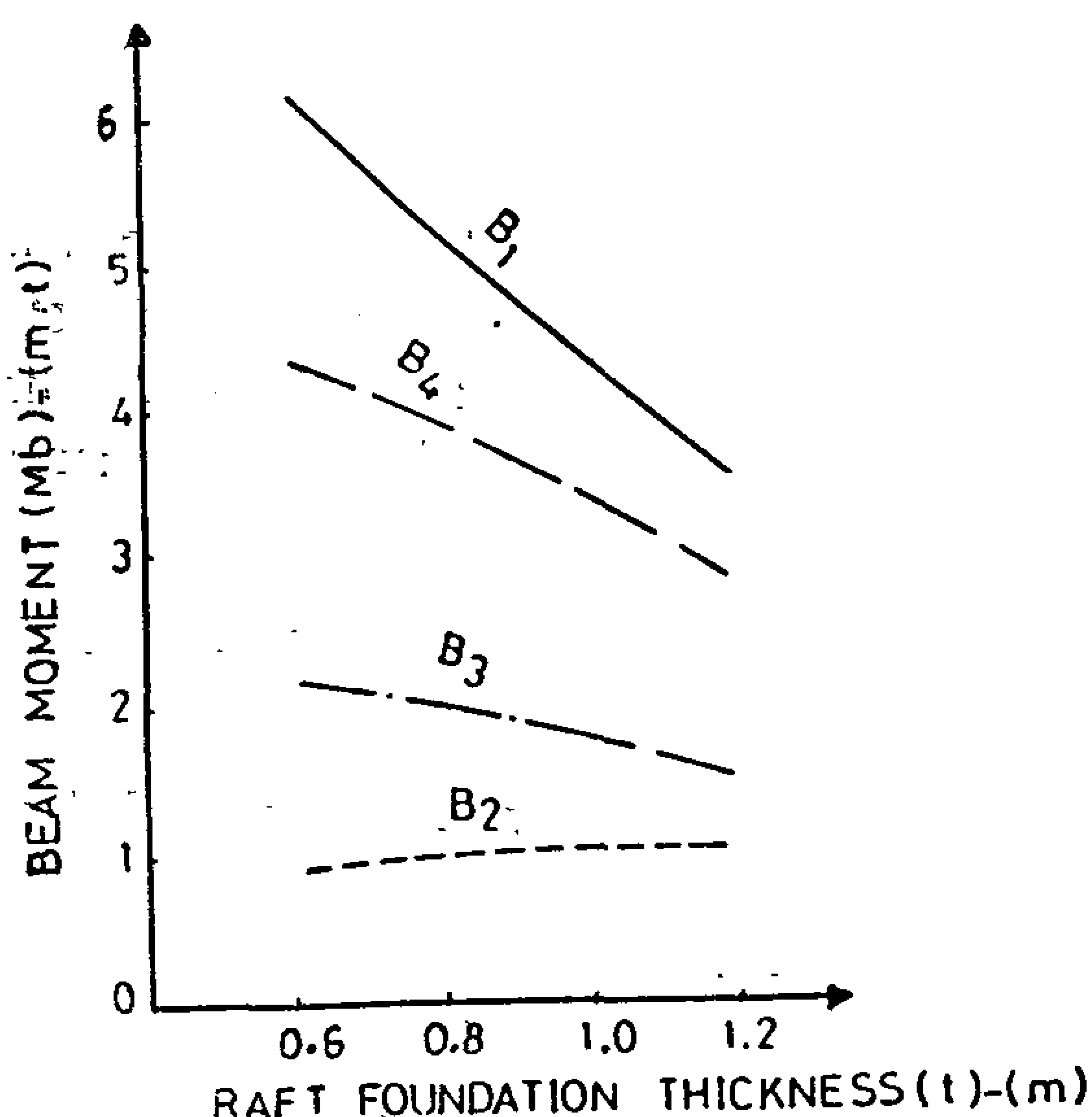


Fig. (19) Effect of the raft foundation thickness (t) on the max. bending moments induced in the beams of the first floor.

2 — Effect of The Soil Modulus of Elasticity

Figure (20) shows the relation between the maximum values of the end moments induced in the beam B1 of the super-structure and the storey number for different soil rigidity represented by its modulus of elasticity. The curve shows that the values of the end moments of the beams of the super-structure decreases with the increase of the soil rigidity.

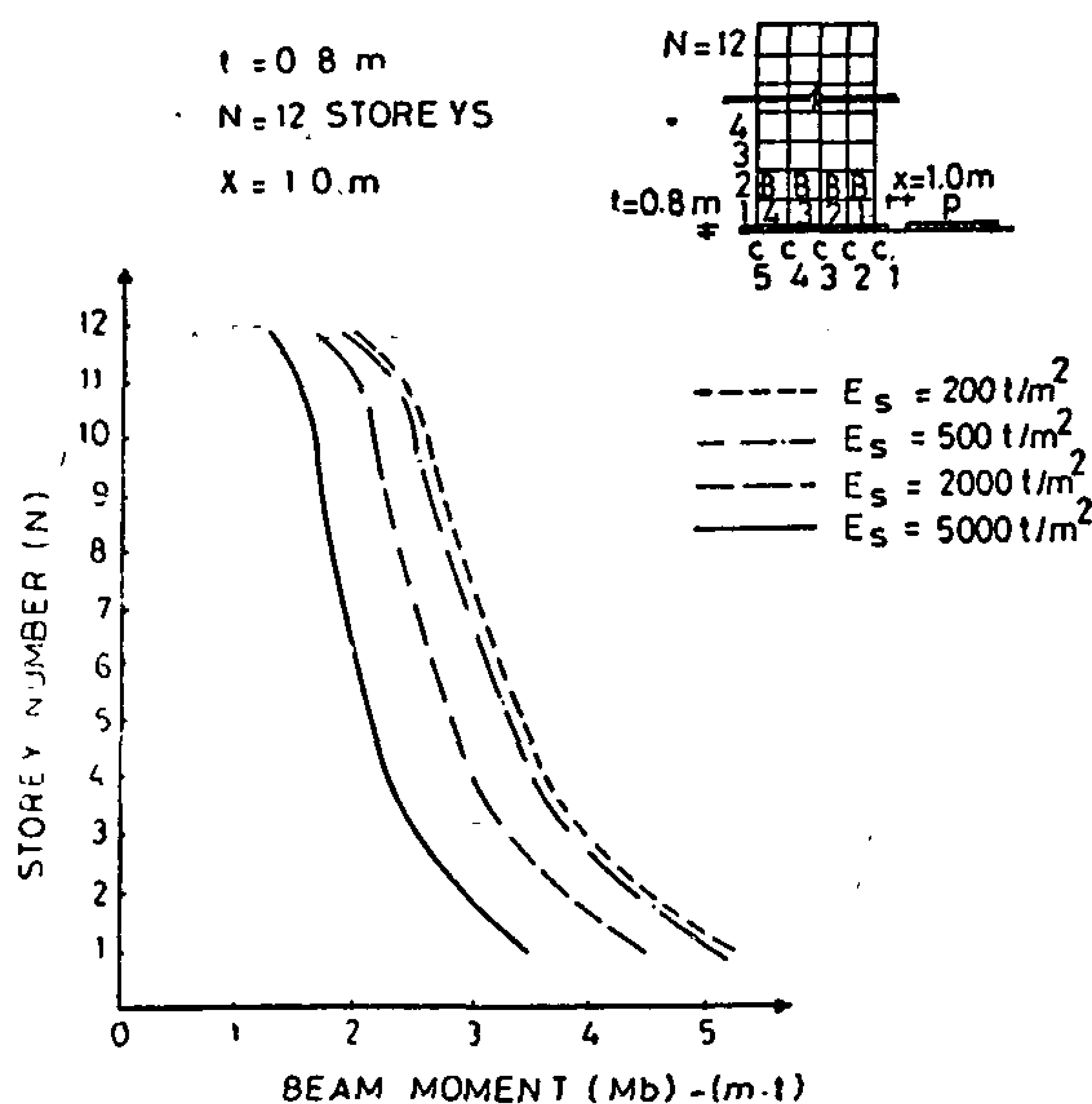


Fig. (20) Max. bending moments induced in beam (B1) for different soil modulus of elasticity (Es).

The effect of the soil rigidity on the maximum end moments induced in the beams of the first floor is presented in figure. (21). The curves presented in this figure show that the end moments induced in the beams of the first floor decrease rapidly with the increase of the soil rigidity from weak soil to soil with medium elasticity while the rate of decrease of these moments is less for stiffer types of soil. These curves also show that the end moment of the beams of the first floor decreases by about 35.3%, 46.8%. 35.1% and 39.7% for beams B1 to B4 respectively due to the increase of the soil stiffness from 200 t/m2 to 5000 t/m2.

The effect of presence of the neighbour load at different load distances from the edge of the building foundation on the bending moments induced in the lower sections of the columns of the first floor is presented in figure (16). This figure shows that the values of the column moments induced at the lower sections decrease rapidly with the increase of the neighbour load distance from 1.0m up to a distance of 6.0m. Furthermore, for the load distance more than 6.0m these moments decrease with a lesser rate. Referring to the same figure it is shown that the moments induced in the lower sections of the columns of the first floor decrease by about 63.3%, 52.0%, 75.3%, 54.8%, and 54.0% for columns C1 to C5 respectively with the increase of the neighbour load distance from 1.0m up to a distance of 6.0m.

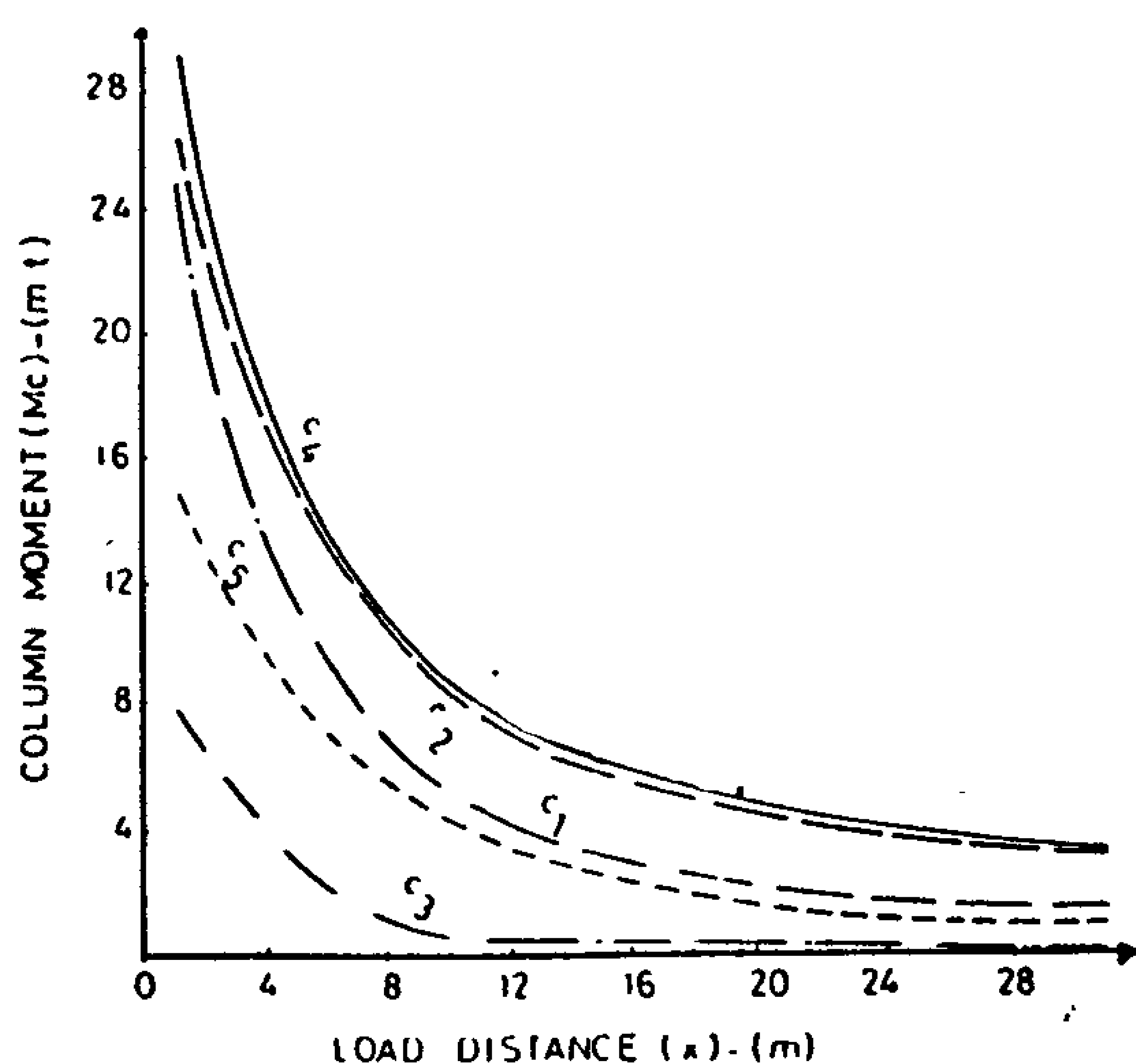


Fig. (16) Effect of the load distance (x) on the bending moments induced at the lower section of the columns of the first floor.

Maximum Bending Moments Induced in The Beams of The Existing Frame Building

The analysis of all the cases studied in this work shows that the presence of the neighbour load causes additional moments in the beams. This is mainly due to the relative settlement between the columns caused by the neighbour load and the corresponding deformations in the different connecting beams.

Figure (17) shows the variation of the maximum bending moments induced in the beams of the super-structure of 12-storey building having foundation thickness of 0.8m and considered supported on soil having modulus of elasticity of 500 t/m2 due to the presence of the neighbour load at a distance of 1.0m from the edge of the existing buiding foundation.

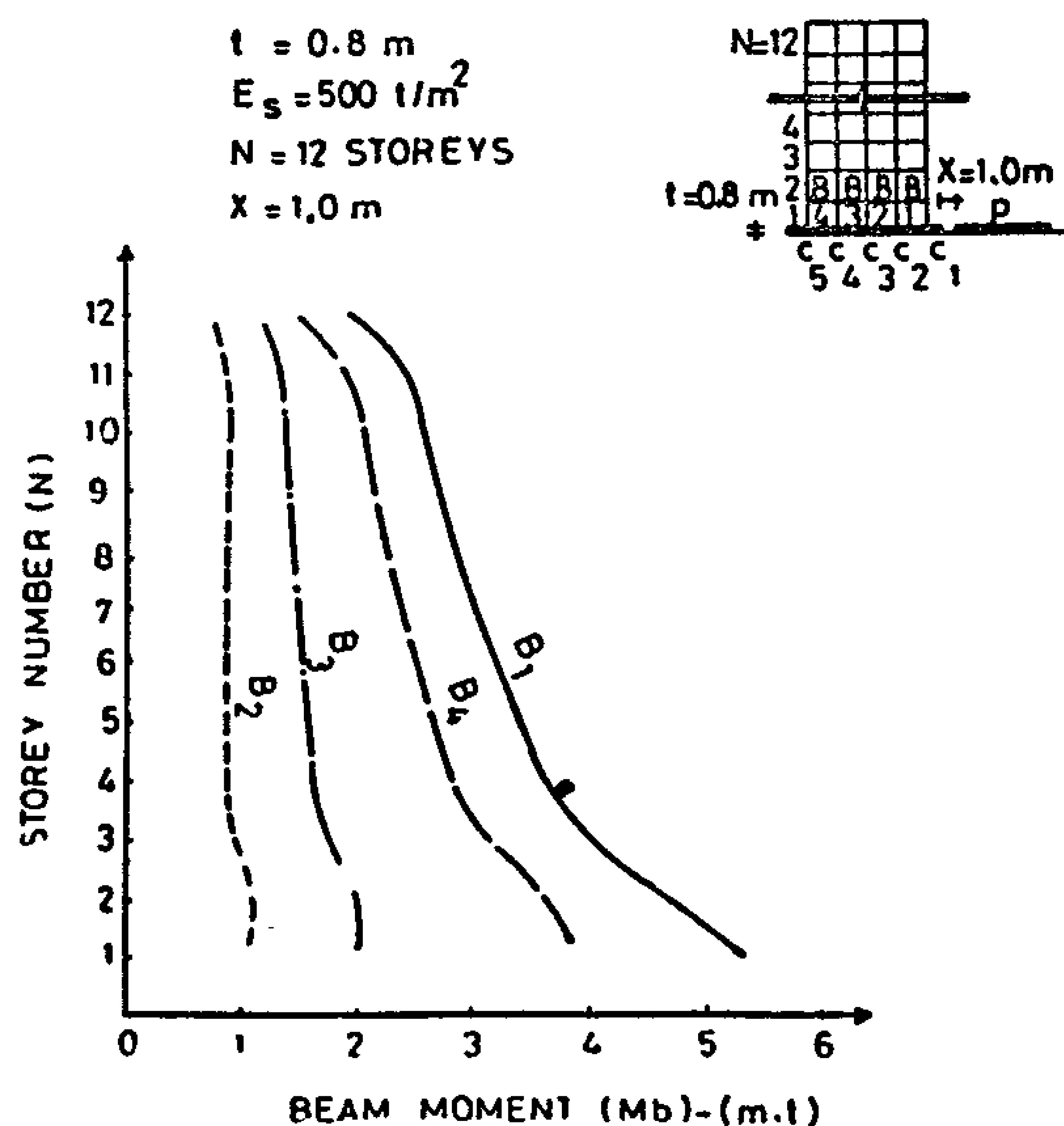


Fig. (17) Effect of the neighbour load on the bending moments induced in the beams of the existing frame building.

This figure shows that the induced moments in the beams of the super-structure is maximum in the beams of the first floor and decreases gradually with the icrease of the storey number.

1 — Effect of The Raft Foundation Thickness

Figure (18) shows the relation between the maximum values of the end moments induced in the beam B1 of the super-structure and the storey number for different raft foundation thickness. The curve indicates that the increase of the foundation thickness reduces the values of the end moments induced in the beams of the super-structure.

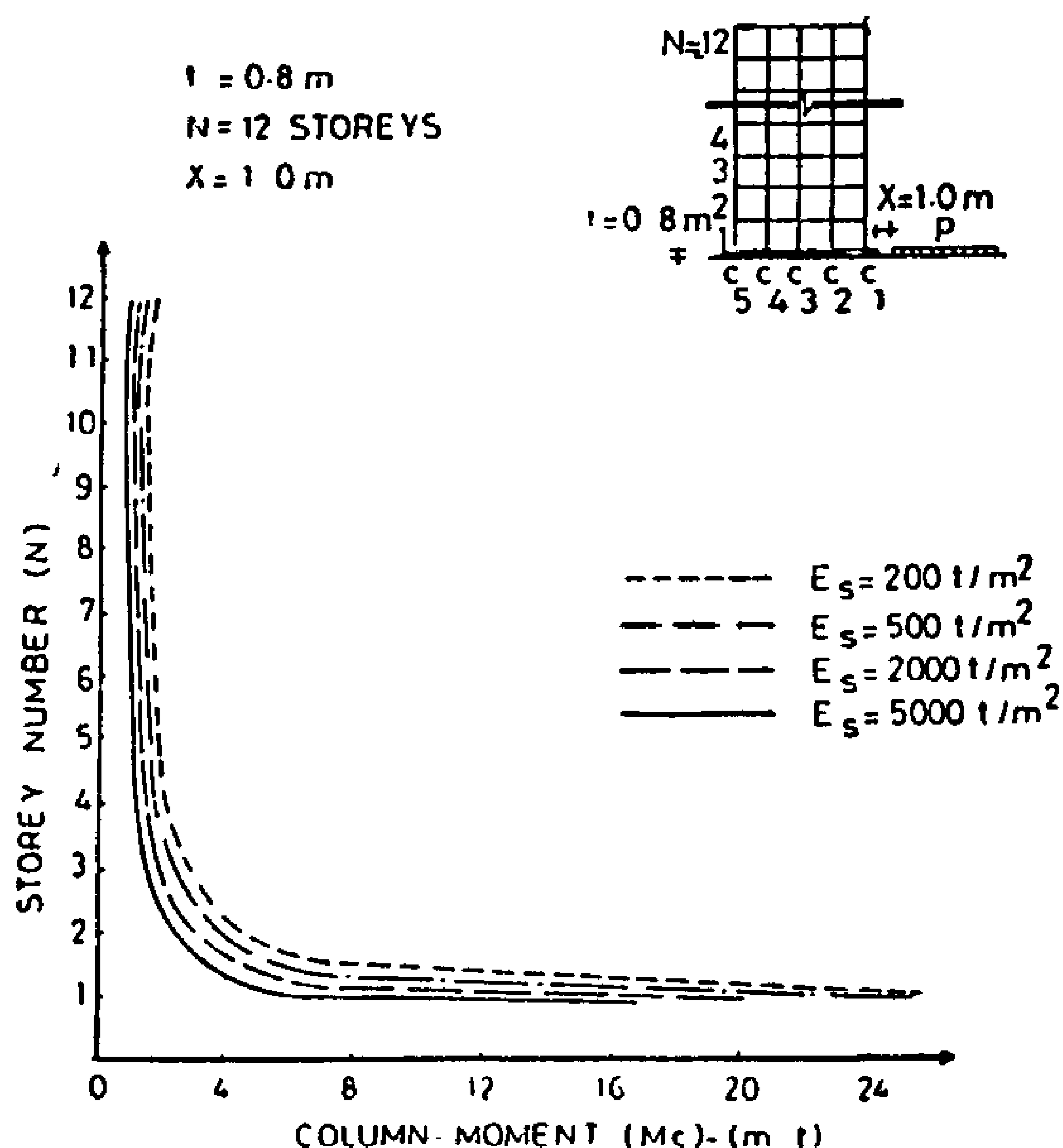


Fig. (13) Max. bending moments induced in column (C1) for different soil modulus of elasticity (Es).

Figure (14) shows the effect of the soil rigidity represented by its modulus of elasticity on the moments induced in the lower section of the columns of the first floor. The curves presented in this figure show that the maximum moments induced in the lower sections of the columns of the first floor decrease rapidly with the increase of the soil rigidity from weak soil to soil with medium rigidity. The rate of decrease of these moments is less for stiffer types of soil. These curves also show that increasing the soil modulus of elasticity from 200 t/m2 to 5000 t/m2, the moments of the lower sections of the columns at the first floor level decrease by about 33.1%, 40.3% 24.8%, 37.6% and 41.1% for columns Cl to C5 respectively.

3 — Effect of The Neighbour Load Distance (X)

The variation of the maximum bending moments induced in the column Cl of the super-structure due to the presence of the neighbour load at different distances from the edge of the existing building foundation are calculated and plotted for each storey figure (15). The figure shows that the values of columns moments are very high in the case where the neighbour load is very close to the building frame i.e. the neighbour load distance (X) is equal to 1.0m from the edge of the building foundation. These moments decrease rapidly as the neighbour load distance increases.

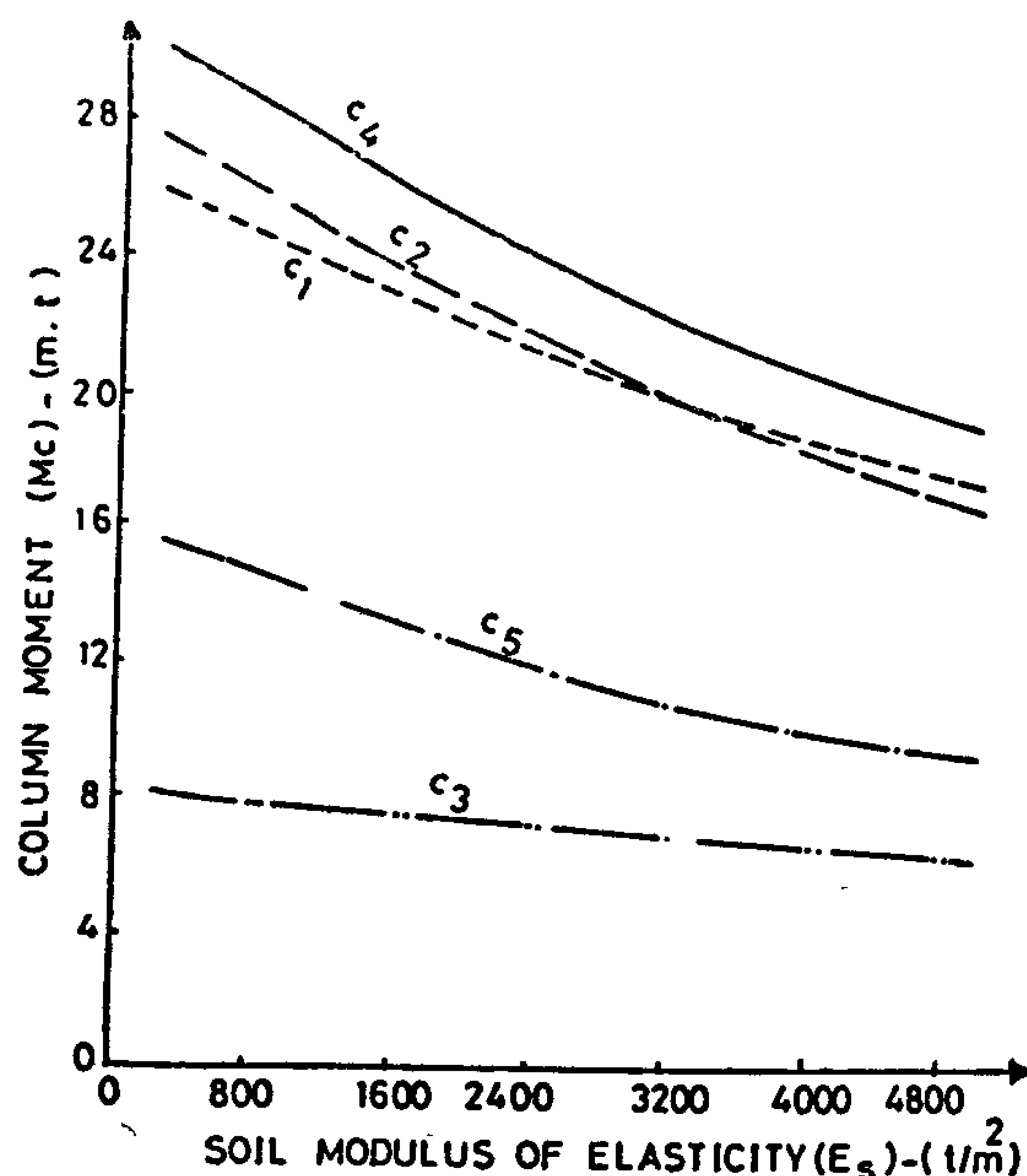


Fig. (14) Effect of the soil modulus of elasticity (Es) on the bending moments induced at the lower section of the columns of the first floor.

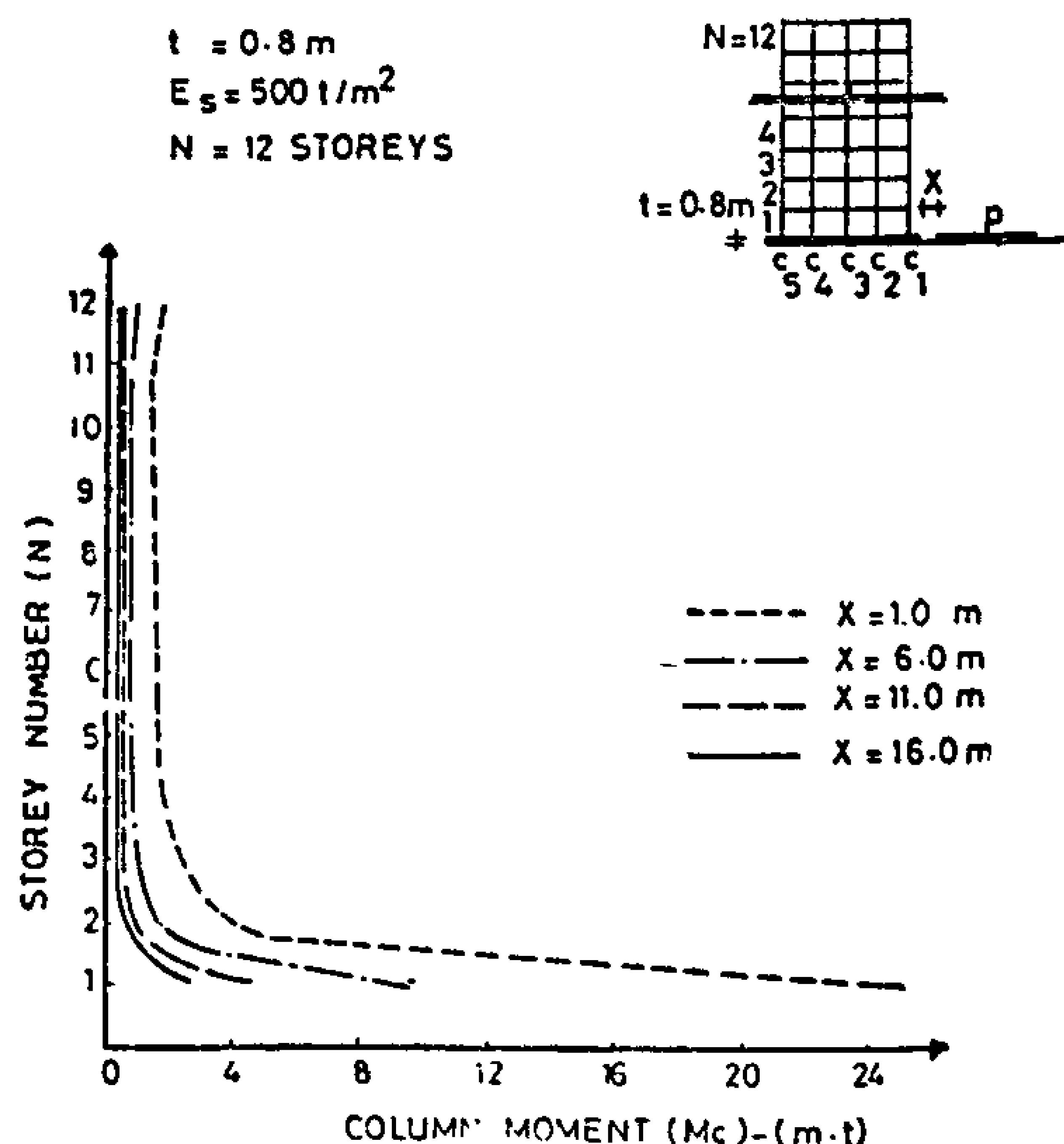


Fig. (15) Max. bending moments induced in column (C1) for different load distance (X).

each storey figure (11). The curve indicates that the values of the column moments decrease with the increase of the foundation thickness.

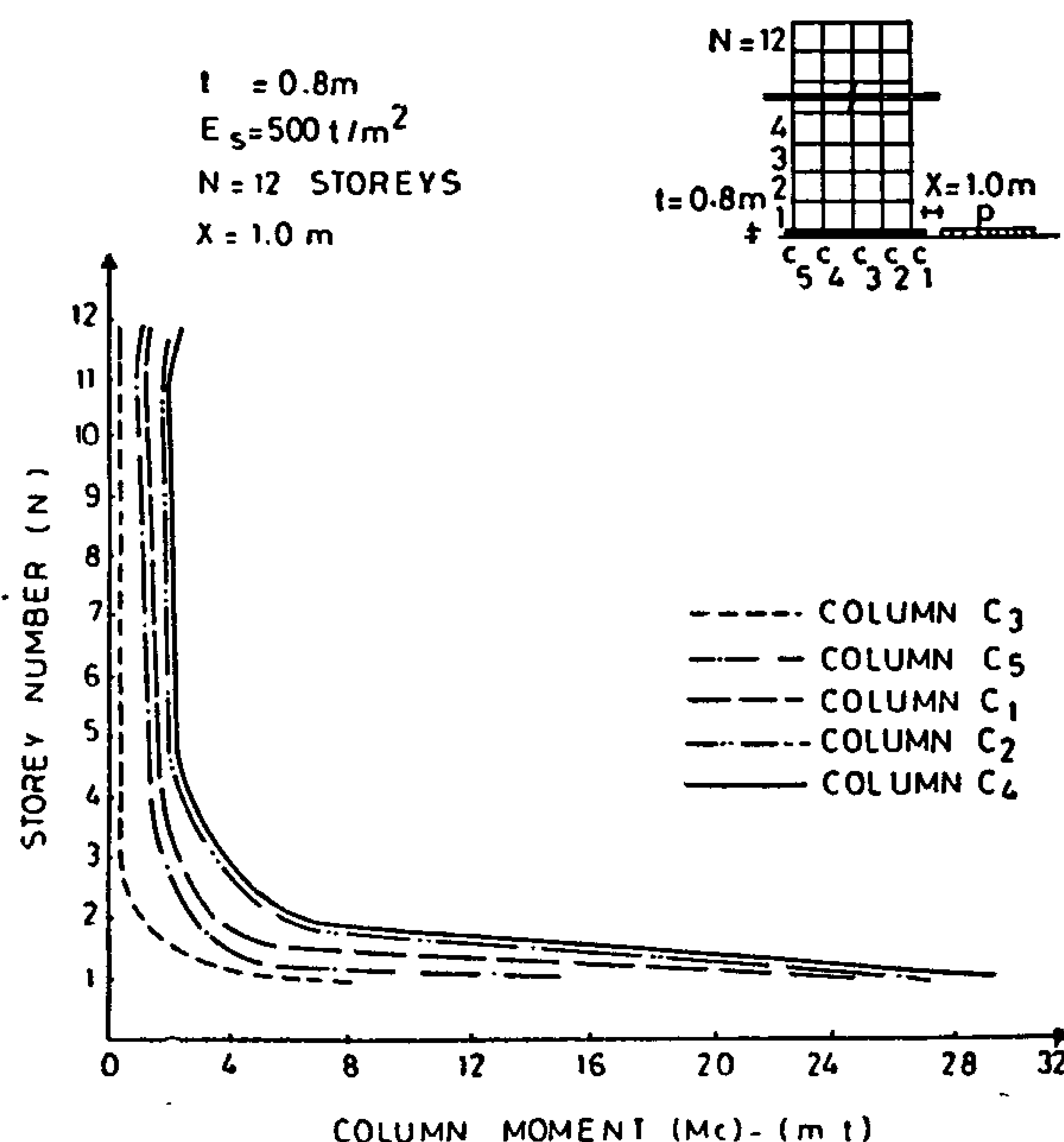


Fig. (10) Effect of the neighbour load on the bending moments induced in the columns of the existing building.

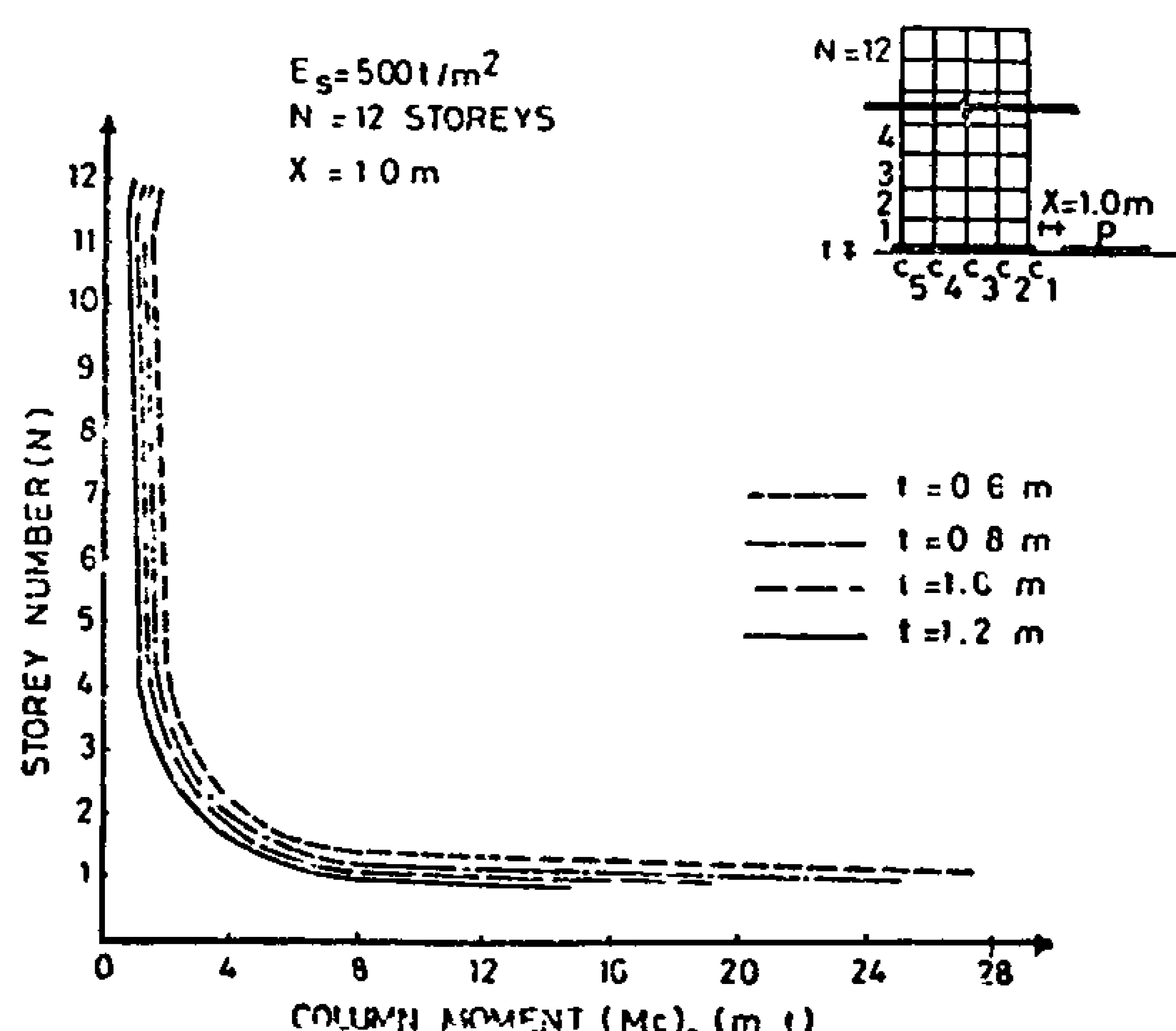


Fig. (11) Max. bending moments induced in column (C1) for different foundation thickness (t).

The effect of the change of the raft foundation thickness on the maximum moments induced in the lower section of the columns of the first floor is presented in figure (12). This figure shows that increasing the raft foundation thickness from 0.6m to 1.2m causes a decrease to the induced moments by about 52.8%, 9.0%, 53.3%, 16.5% and 40.5% for columns Cl to C5 respectively.

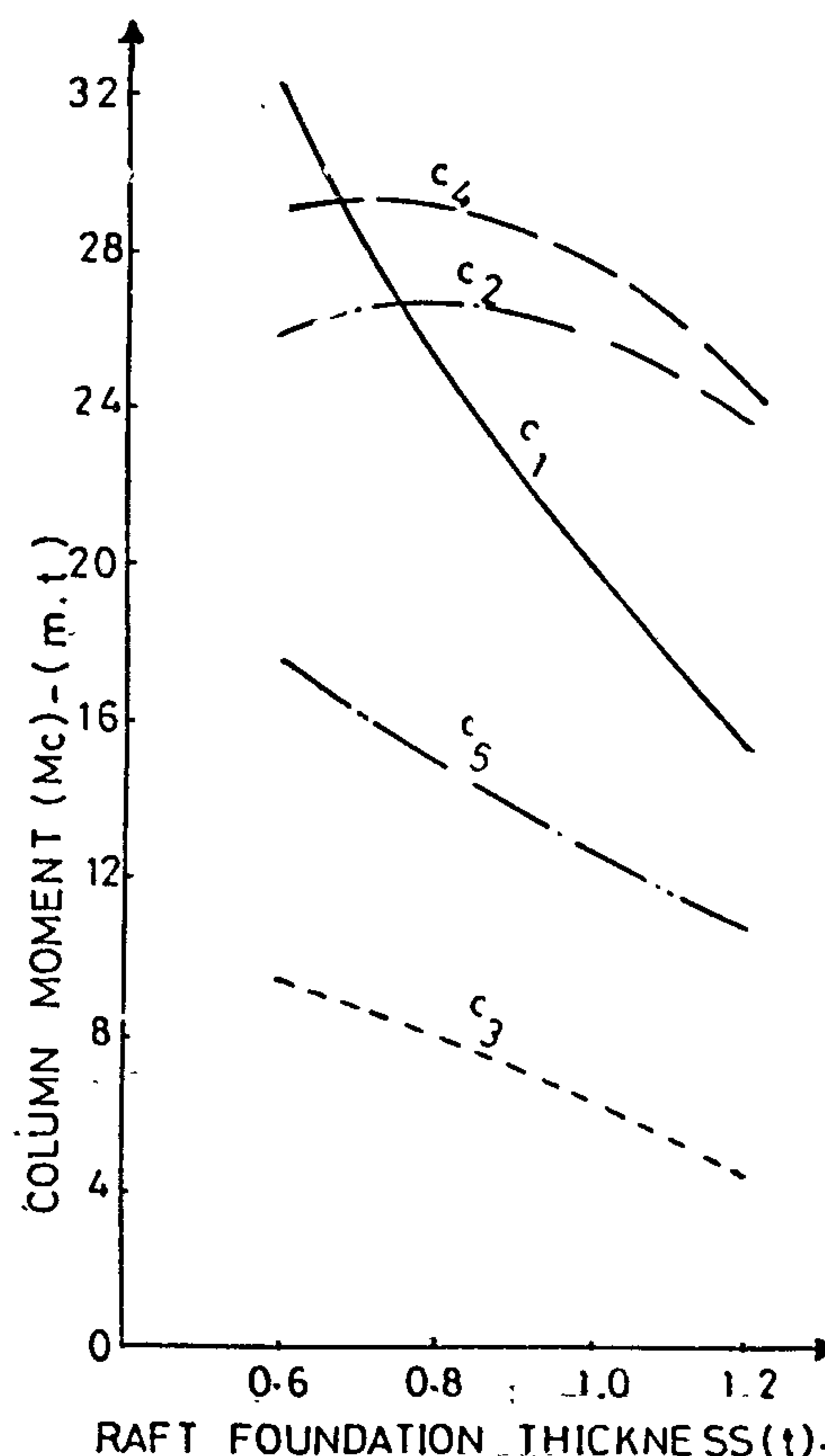


Fig. (12) Effect of the raft foundation thickness (t) on the bending moments induced at the lower secotion of the columns of the first floor.

2 — Effert of The Soil Modulus of Elasticity

The values of the maximum bending moments induced in the column Cl of the super-structure for different soil modulus of elasticity are calculated and plotted for each storey figure (13). The curve explains that the induced column moments decrease with the increase of the soil modulus of elasticity.

figure (8). The curves shows that the additional axial loads in the columns of the super-structure is very high in case that the neighbour load is very close to the building frame i.e. the neighbour load distance (X) is equal to 1.0m from the edge of the existing building foundation. It is also shown that the values of the additional column loads is rapidly decreased by increasing the neighbour load distance.

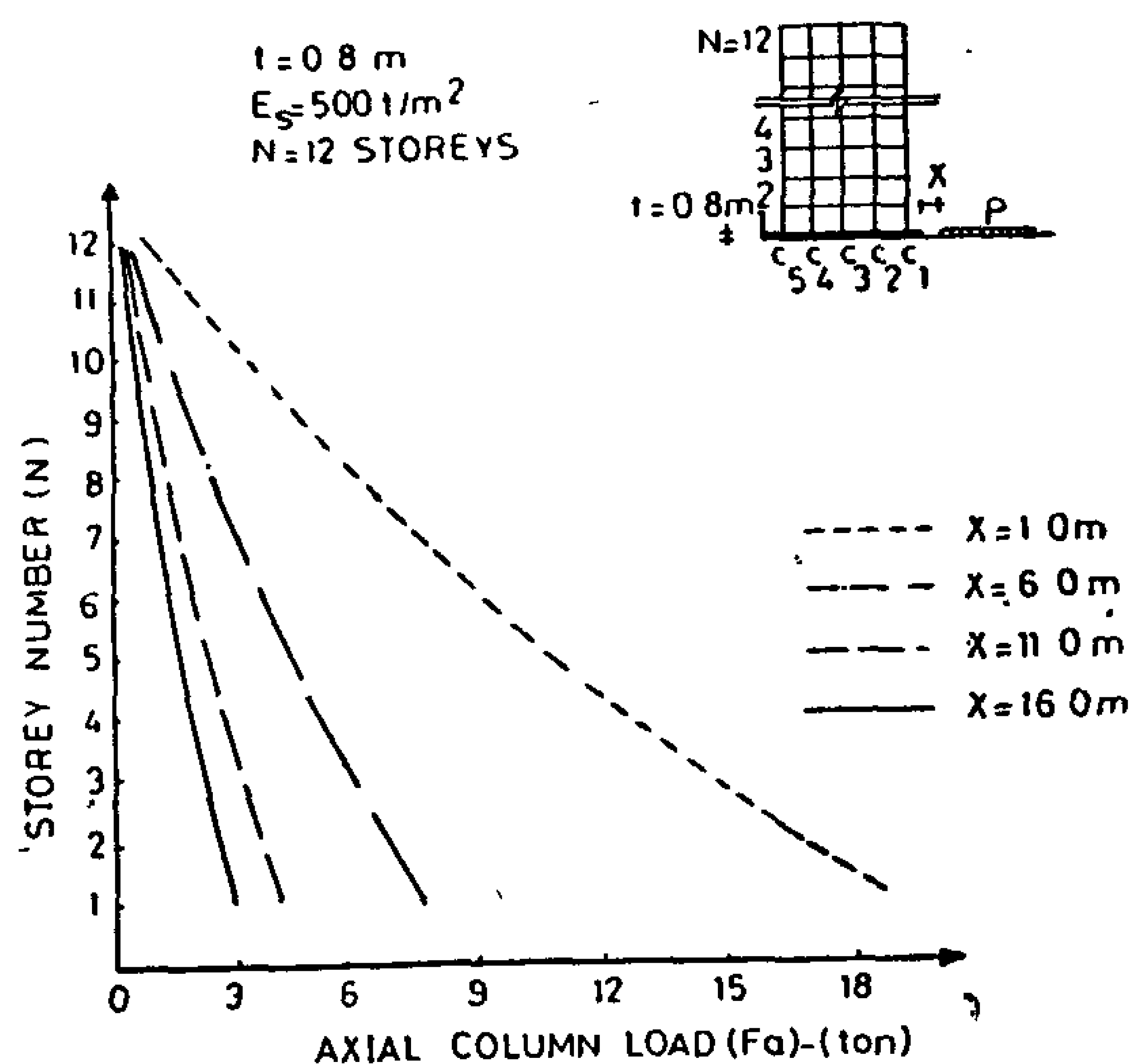


Fig. (8) Axial loads induced in column (C1) for different load distance (X).

The effect of the neighbour load distance on the maximum axial loads induced in the columns at the first floor level is shown in figure (9). The curves given in this figure indicate that the values of the axial columns loads decrease rapidly with the increase of the neighbour load distance from 1.0m up to a distance of 6.0m where the additional axial loads in the columns decrease less steeply with the more increase of the load distance. Referring to the same figure it is shown that the additional columns loads decrease by about 59.3%, 63.7%, 54.4% and 48.4% and 54.8% for columns Cl to C5 respectively with the increase of the neighbour loads distance from 1.0m up to a distance of 6.0m.

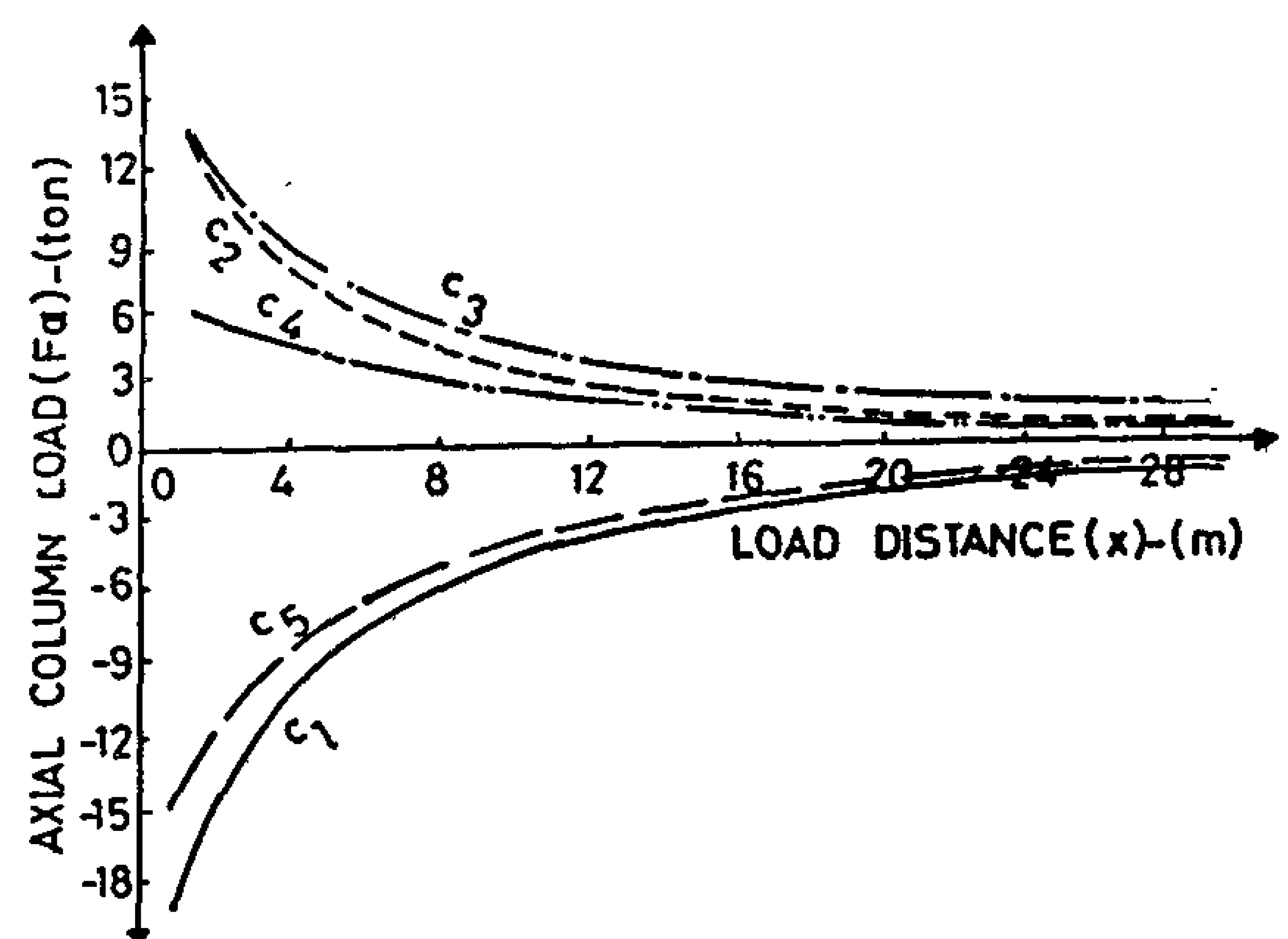


Fig. (9) Effect of the load distance (X) on the axial loads induced in the columns of the first floor.

Maximum Bending Moments Induced in The Columns of The Existing Frame Building

The variation of the moments induced in the columns of a 12-storey building due to the presence of the neighbour load at a distance of 1.0m from the edge of the existing building foundation is given in figure (10). In the analysis the foundation thickness was taken as 0.8m and a soil modulus of elasticity of 500 t/m2 was considered. Referring to the same figure it is shown that the maximum induced moments in the columns of the super structure due to the presence of neighbour load takes place at the lower sections of the columns of the first floor. It is also shown that the additional column moments induced in the second floor are much smaller than those of the 1st floor and are nearly equal to one fifth those of the first floor. Moreover, the values of column moments continue to decrease gradually with the increase of the height of the superstructure.

1 — Effect of The Raft Foundation Thickness

The values of the maximum bending moments induced in the column Cl of the super-structure for different foundation thicknesses are calculated and plotted for

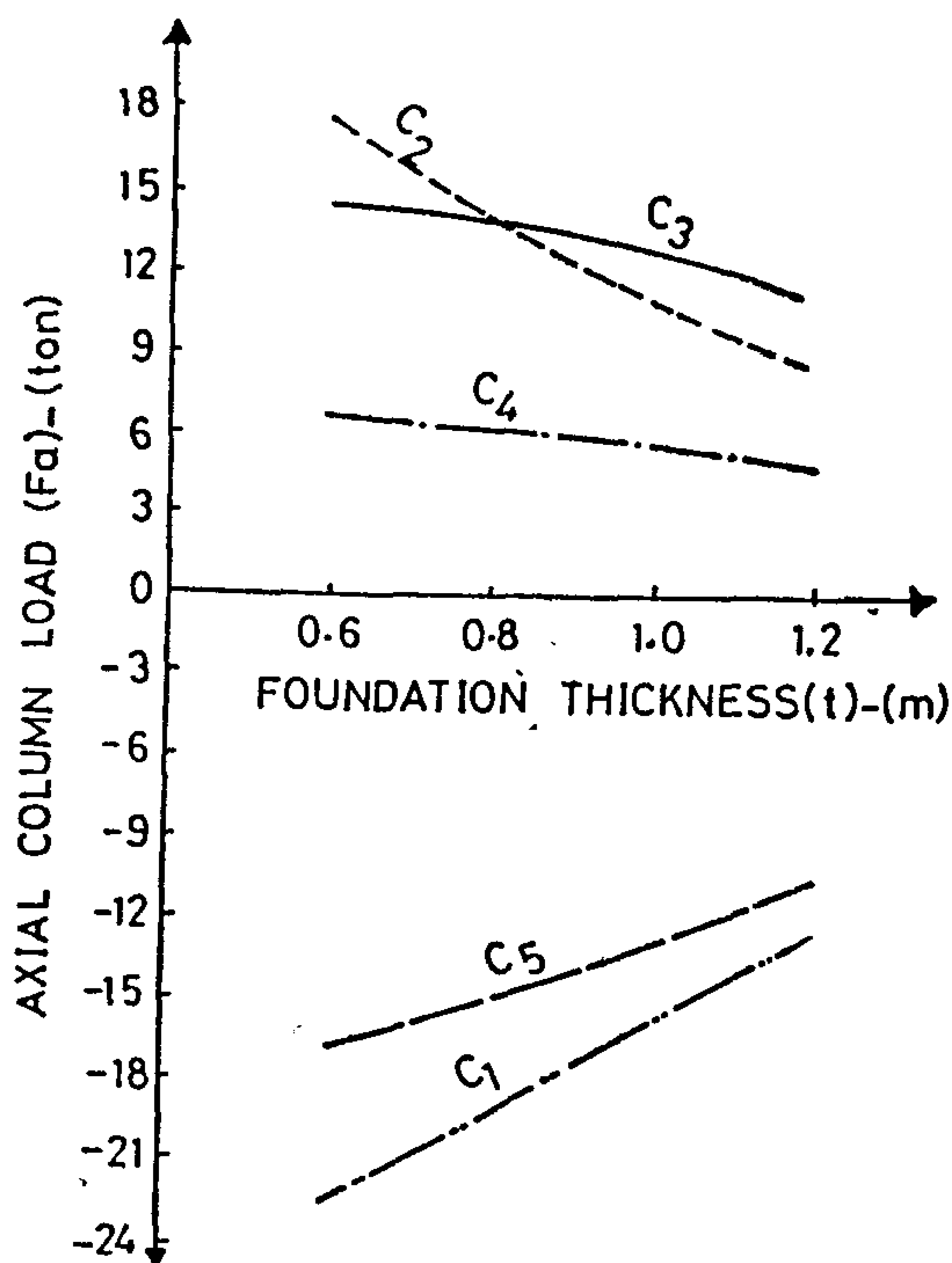


Fig. (5) Effect of the raft foundation thickness (t) on the axial loads induced in the columns of the first floor.

2 — Effect of The Soil Modulus of Elasticity

Figure (6) shows the variation of addional axial loads induced in the column Cl due to the presence of the neighbour load and for different soil rigidity represented by its modulus of elasticity. The presented curve shows that the additional column loads decrease with the increase of the soil rigidity. It is also shown the change in the additional column loads is maximum at bottom of the building and decrease steadily upwards.

Figure (7) shows the effect of soil rigidity represented by its modulus of elasticity on the maximum axial loads induced in the columns of the first floor. The curves presented in this figure show that the change of column loads of the first floor is maximum in case of weak soil and decrease repidly with the increase of the soil rigidity from weak soil to soil with medium rigidity and then gradually for stiffer types of soil. The curves also show that increasing the soil modulus of elasticity from 200 t/m2 to 5000 t/m2 causes a decrease to the induced axial loads for the columns of the first floor by about 36.0% & 32.8% & 39.0 & 45.5% and 39.5% for columns Cl to C5 respectively.

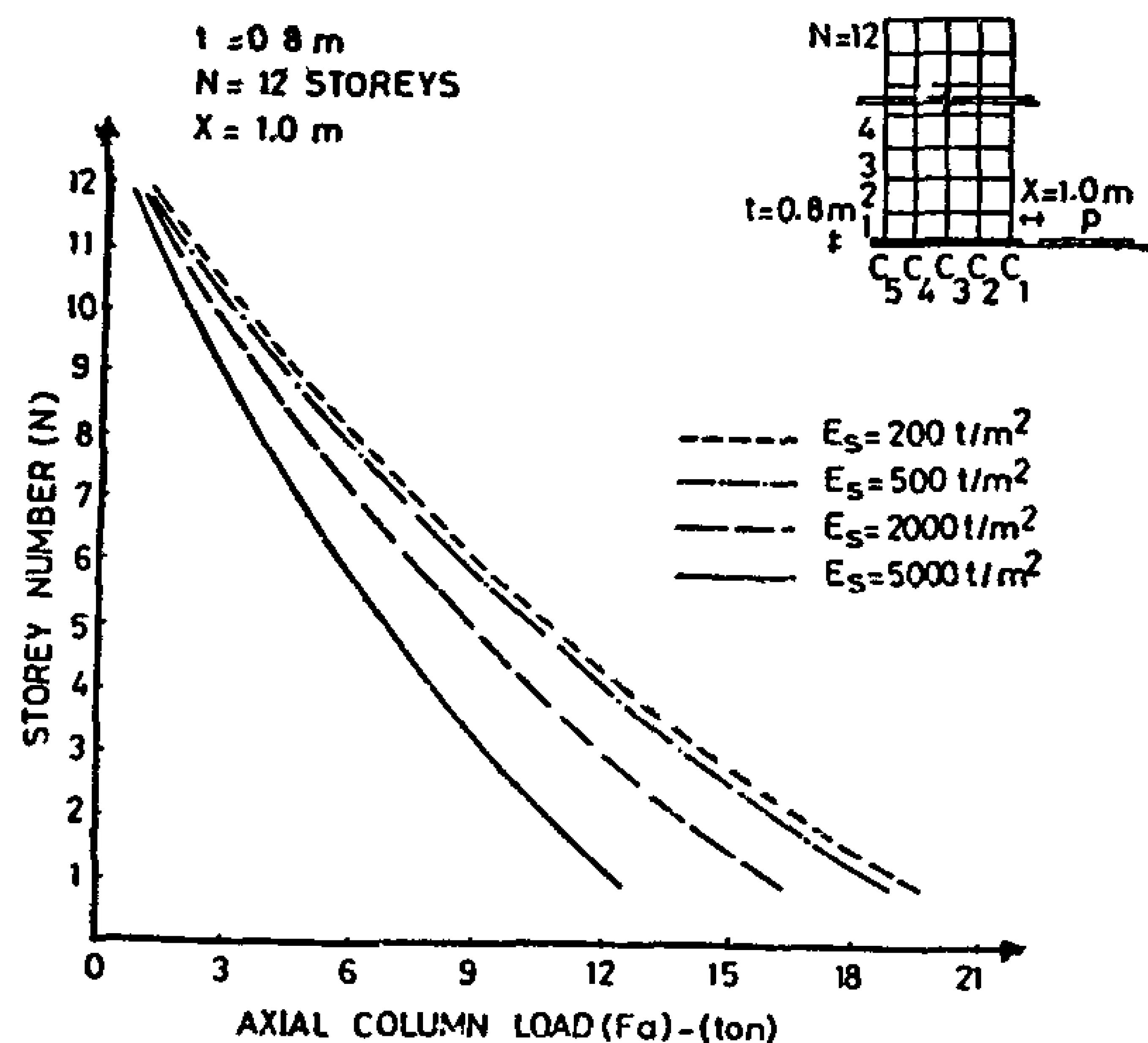


Fig. (6) Axial loads induced in column (C1) for different soil modulus of elasticity (Es).

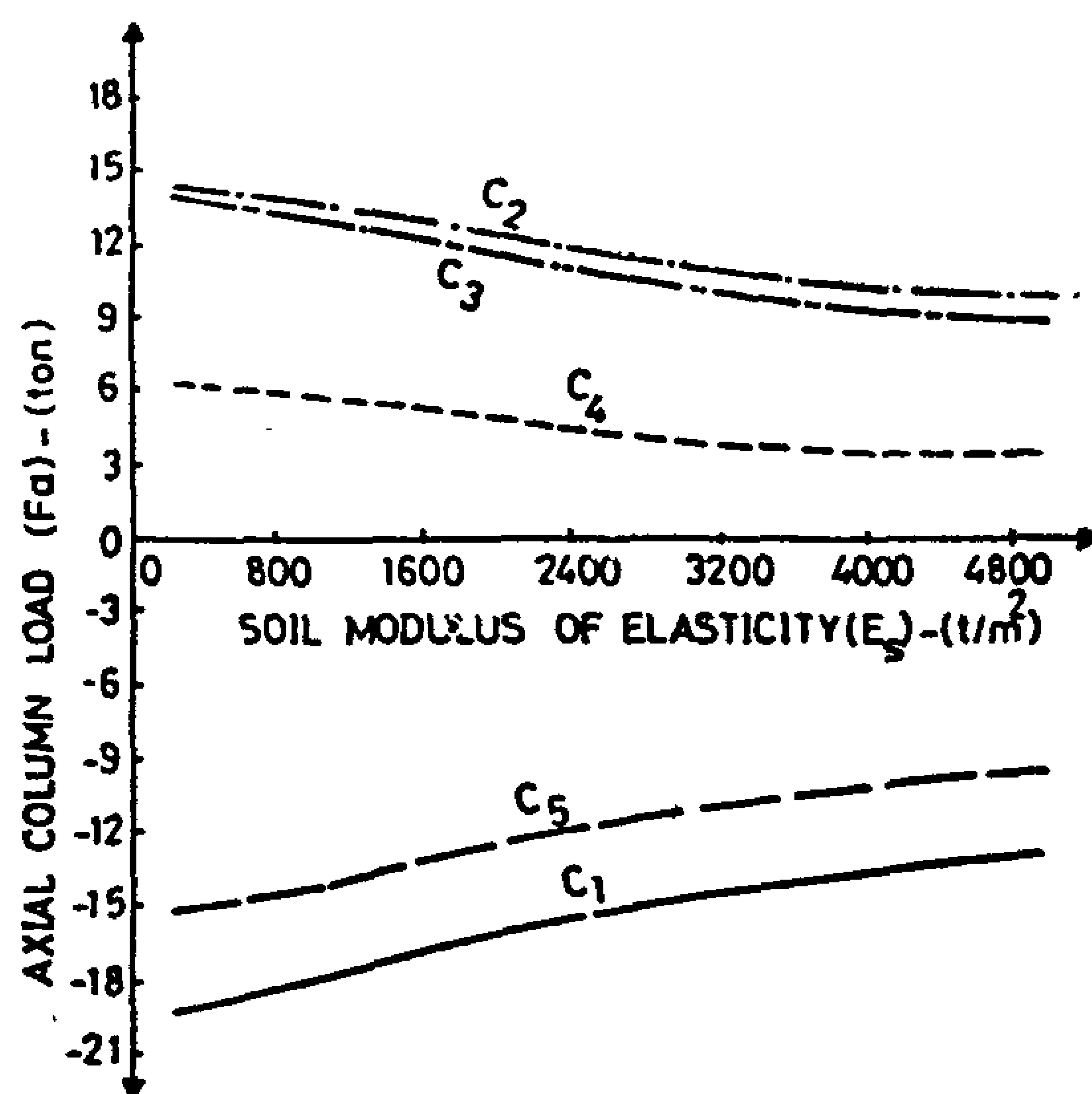


Fig. (7) Effect of the soil modulus of elasticity (Es) on the axial loads induced in the columns of the first floor.

3 — Effect to The Neighbour Load Distance (X)

The variation of additional axial loads in the column Cl of the super-structure due to the presence of the neighbour load at different distances from the edge of the existing building foundation is shown in

ADDITIONAL AXIAL LOADS IN THE COLUMNS OF EXISTING FRAME BUILDING

The addtional axial column load is mainly attributed to the relative settelement between columns due to the presence of the neighbour load. This causes an increase in the loads of the inner columns and a corresponding decrease in those of outer columns as shown in figure (3).

Figure (3) explains the additional axial loads induced in the columns of the superstructure of 12-storey building having foundation thickness of 0.8m and considered supported on soil having modulus of elasticity of 500 t/m2 and the neighbour load existed at a distance of 1.0m from the edge of the existing building foundation. This figure shows that the additional column load is maximum for the columns of the first floor and decrease gradually for the columns of the upper storeys.

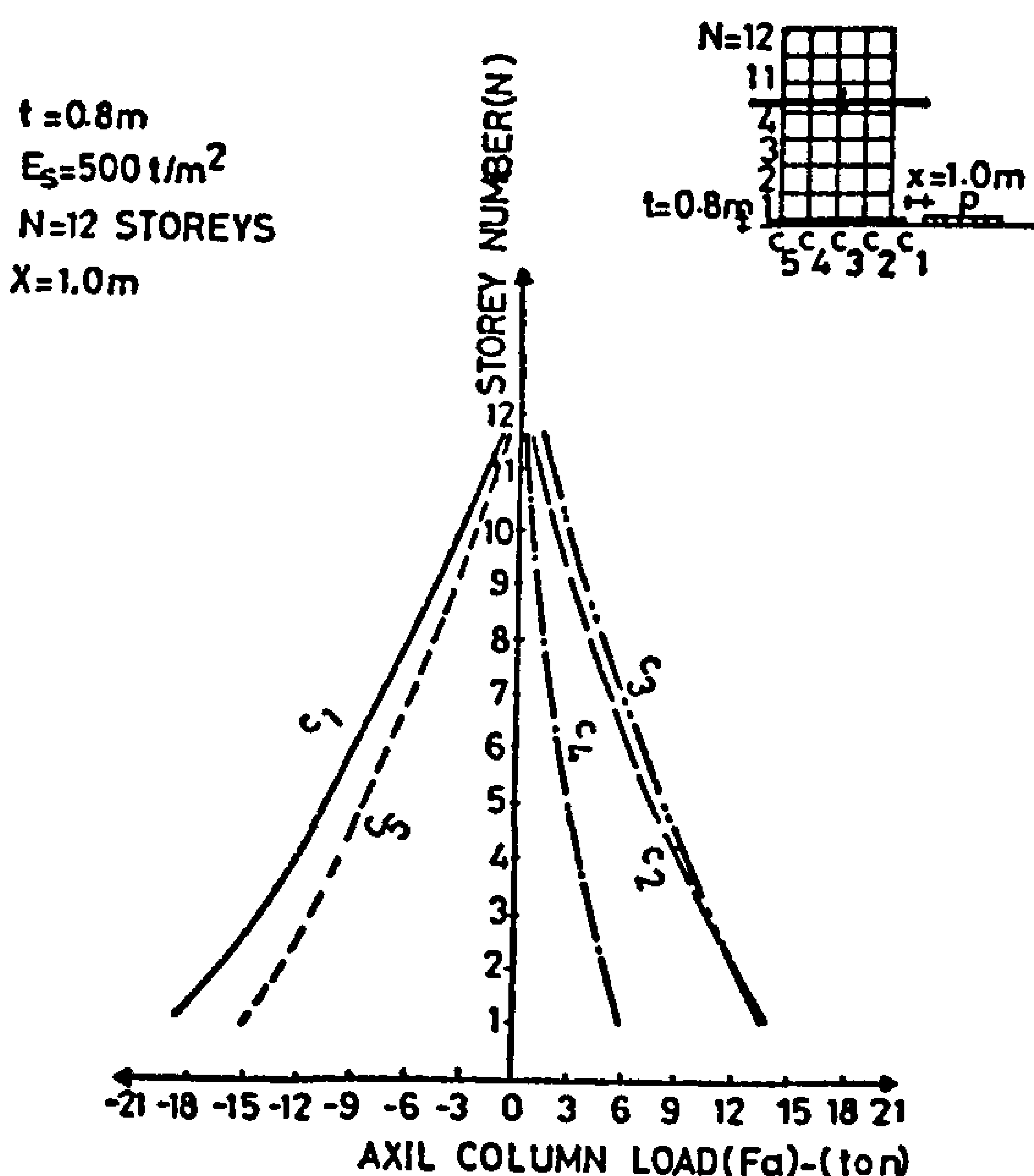


Fig. (3) Effect of the neighbour load on the axial loads induced in the columns of the existing frame building.

1 — Effect of The Raft Foundation Thickness

Figure (4) shows the variation of additional axial loads induced in the column Cl due to the presence of the neighbour load for different values of foundation thicknesses. The curves presented in this figure show that increasing the raft foundation thickness decreases the values of the additional column loads. It is also shown that the change in the additional column loads is maximum at the bottom of the building and decrease steadily upwards.

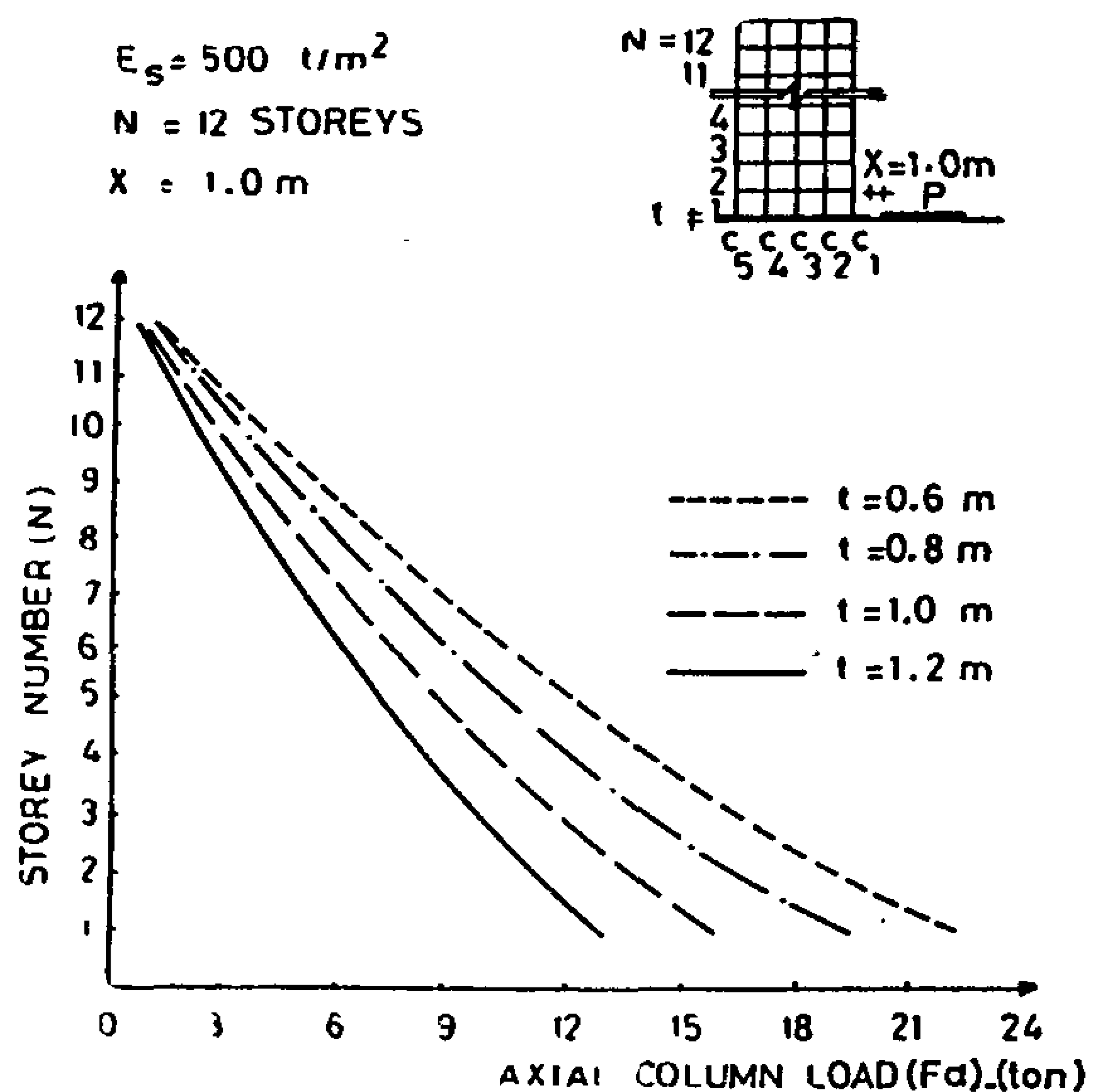


Fig. (4) Axial loads induced in column (C2) for different foundation thickness (t).

Figure (5) shows the effect of changing the raft foundation thickness of the maximum axial loads induced in the columns of the first floor. The curves presented in this figure shows that increasing the raft foundation thickness from 0.6m to 1.2m causes a decrease to the indced axial loads for the columns of the first floor by about 42.3%, 52.4, 26.0%, 33.15% and 35.2% for columns Cl to C^5 respectively.

All the building frames were investigated under the action of a neighbour uniformly distributed load equal to 40t/m simulating the effect of a neighbour building of about 8-storeys rested on a raft foundation of 20ms breadth. The distance between the neighbour load and the edge of the existing building (X) was assumed to vary from 1.0m to 18.m. The building was analyzed for foundation thickness equal to 0.6, 0.8,1.0 and 1.2ms to investigate the effect of foundation rigidity. The modulus of elasticity of the soil was assumed to vary from 2/0 t/m2 for weak soil to 5000 t/m2 for stiff soil [3].

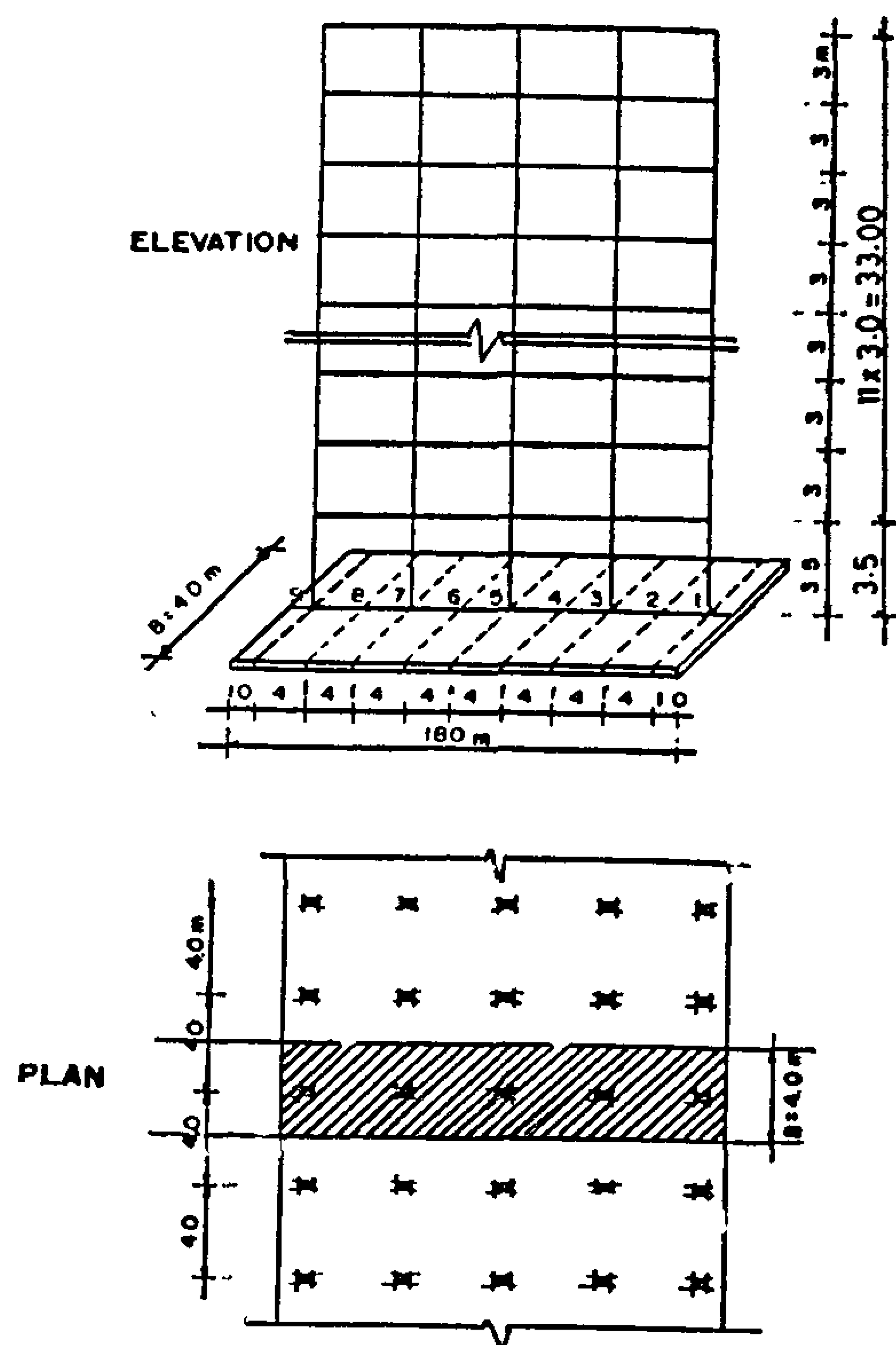


Fig. (1) Configuration of the structural model.

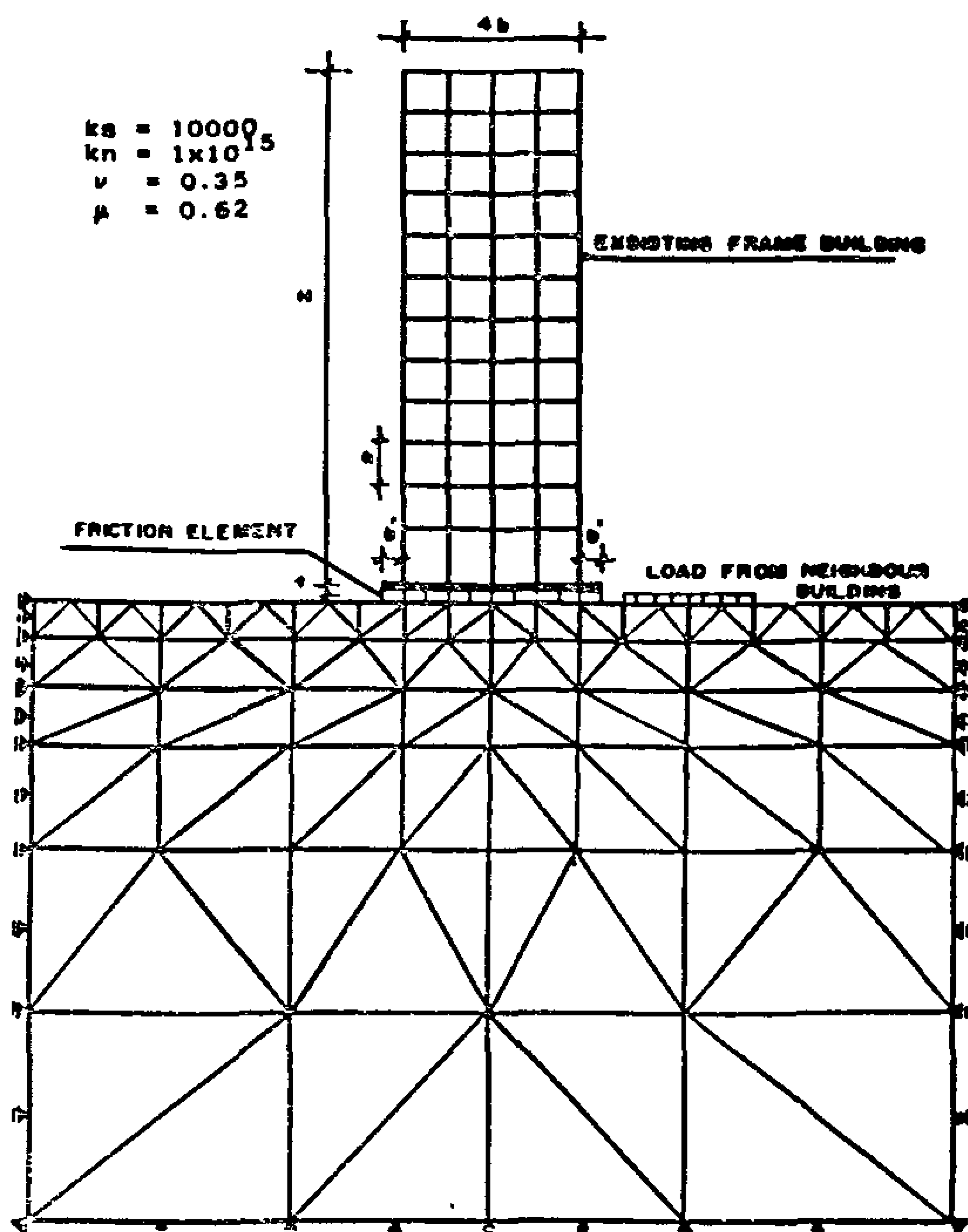


Fig. (2) Typical finite element mesh

Storey Number	1,2	3,4	5,6	7,8	9,10	11,12
External Columns	30X100	30X90	30X85	25X85	25X75	25X65
Internal Columns	40X140	40X130	35X125	35X110	30X110	30X95

TABLE (1) Columns cross-section (cm)

EFFECT OF ERRECTION OF A NEW BUILDING ON THE STRAINING ACTION OF THE SKELETON OF AN ADJACENT BUILDING

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ABSTRACT

The construction of a new building may affect the hehaviour of the existing adjacent one. The effect may be of special importance in the case of building frames resting on raft foundations especially on clay soil. This effect depends on the stratum conditions as well as the relation of the super-structure and the foundation.

In this study, a finite element model of a four bay multistorey building frame restng on a raft foundation supported on a clay soil media is used to investigate the effect of a new building on the straining actions of the skeleton of an existing adjacent building (Figure 1). The straining actions considered are column's loads, column's bending moments and beam's bending moments.

INTRODUCTION

A complete solution to the soil structure interaction proplem must satisfy compatability and equilibrium between the three elements of the system; the super-structure, the raft and the supporting soil. However, before compatability between the raft and the supporting soil can be expressed, it is necessary to adopt a model for all soil behaviour and can represent the soil settlement along the contact surface. Some approaches are of common use to represent the soil behaviour, namely, the Winkler model, the clastic half space model, the finite element model and the boundary element model.

The finite element model has relatively considerable flexibility in assigning and modifying the different material properties for individual soil and interface elements. Several practical problems can be investigated using just one model.

FINITE ELEMENT MODEL

The finite model proposed in this work consists of regular frame elements representing the building frame and it's raft foundation and linear strain triangular elements representing the soil. Friction elements are introduced to idealize the interface between the raft foundation and the subgrade soil (Figure 2). A complete describtion of the finite element program used in the analysis is found in reference 1 and 2. The cross-section of all the columns of the frame were taken as presented in table (1). Breadth of all beams was taken equal to 0.12m. and their depth 0.7m.

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JOURNAL OF THE EGYPTIAN SOCIETY OF ENGINEERS

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VOL. 27 ISSUE No. 2 1988

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— Articles may not exceed 8 pages. In this respect, mathematical derivation may be abbreviated and tables replaced by curves.

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مجلة جمعية المهندسين المصرية

٢٨ شارع رمسيس ـ القاهرة ج٠م٠ع ت ٧٤٠٥٦٩/٧٤٠٤٨٨

المجلد السابع والعشرون : **العدد الثالث ١٩٨٨**

- تصدر المجلة ربع سنوية .
- ترسل النصوص المطلوب موافقة هيئة التحرير على نشرها باسم السيد / رئيس التحرير . وهو غير مسئول عن فقد أو تلف أى نص .
- تنشر المجلة المقالات التى تسهم فى رفع مستوى العلوم الهندسية وطرق ممارستها .
- تقبل للنشر المقالات بأحدى اللغتين العربية أو الانجليزية على الآلة الكاتبة ومعها ملخص بكل من اللغتين .
- المجلة غير مسئولة عن الأراء والمحتويات التى تنشر وهى تعبر عن كاتبها فقط .
- تذكر أسماء أصحاب المقالة كاملة باللغتين ومعها القابهم العلمية ووظائفهم .
- يراعى ألا تتجاوز المقالة ٨ صفحات بالمجلة ، وفى سبيل ذلك يختصر الاشتقاق الرياضى ويستعاض عن الجداول بمنحنيات مرسومة بالحبر الشينى الأسود ، على أن يشغل المنحنى نصف صفحة على الأكثر ولا يشغل صفحة كاملة الا فى حالات استثنائية وسيصغر أى منحنى الى تلك المقاسات .

ويراعى الا يقل ارتفاع الحروف أو الأرقام على المحنيات المنشورة عن ٣ مم بعد التصغير .

- يعنى بذكر المراجع المستقى منها المقال وتصنف تبعا لاسم المؤلف ثم العنوان ثم المجلة أو الكتاب وتاريخه .

اشتراكات المجلة :

يتلقى أعضاء الجمعية نسخهم مجانا .

ولغير الأعضاء :

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الاشتراك السنوى لغير المهندسين	**٥٠ جنيها**
الاشتراك السنوى للهيئات	**٥٠٠ جنيه**

وخارج مصر :
للافراد ٧٥ دولار أمريكى سنويا .
وللهيئات ٥٠٠ دولار أمريكى سنويا .

وذلك عن الأربع اعداد السنوية ويعامل العدد الواحد بواقع الربع من هذه القيمة .

وتعطى أولوية النشر بالمجلة للسادة الزملاء أعضاء جمعية المهندسين المصرية .

رقم الايداع بدار الكتب ١٩٨٣/٢٩٨

طبعت بمطابع دار الشعب

محتويات العدد

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التشييد والبناء

جمعية المهندسين المدنيين
جمعية المهندسين المعماريين
جمعية مهندسى الرى

المعاهد التكنولوجية
وتكوين فئات العمل الهندسي فى مصر

أ.د علي محمد كامل
أ.د محمد فهيم صقر
أ.د أحمد خالد علام

اتجهت وزارة التعليم اخيرا نحو بعث فكرة المعاهد التكنولوجية بدافع الرغبة فى تكامل فئات العمل الهندسي فى مصر لزيادة فعاليته فى التنمية، وهو مقصد واع بما جرى فى البلاد المتقدمة تكنولوجيا فى صدد تكوين البنية الهندسية من فئتين تكملان بعضهما : احداهما يقال لها أكاديمية وتركز على تنمية قدرات الابداع والتطوير والتصميم ، والأخرى يقال لها تكنولوجية وتركز على تنمية قدرات التنميط والاتقان وتنظيم الانتاج .

وليس هذا الفكر بغريب عن مصر فقد انتبهت اليه فى الثلاثينات فانبثقت منه بجانب كلية الهندسة الجامعية مدرستان للهندسة التطبيقية العليا احداهما فى القاهرة والأخرى فى الاسكندرية ، ثم ذابتا فى التعليم الجامعى فأصبحت احداهما كلية الهندسة بجامعة ابراهيم ثم بجامعة عين شمس وتحولت الثانية الى كلية الهندسة بجامعة فاروق . ثم تجدد هذا الفكر فى الخمسينات فأثمر مجموعة من المعاهد سرعان ما فقدت هويتها اذ أصبحت هجينا من التعليم المهنى والنظرى لم يعد يجد لخريجيه طلبا فى مصر . وفى الستينات تحمست المانيا فجهزت معهدا تكنولوجيا فى حلوان على نمط معاهدها التكنولوجية التى تعمل بجانب الكليات الجامعية فى تكامل فئات العمل الهندسي ، ولم يلبث هذا المعهد أن تخلى عن طابعه التكنولوجى التطبيقى وتحول الى كلية هندسة بجامعة حلوان كأمثاله السابقين .

وقد تشاورت مجموعة اساتذة الهندسة المصريين ممن قرنوا الخبرة الهندسية بالخبرة التعليمية الذين يقدمون المقال الحالى فى أسباب ما تقدم من احباط التعليم التكنولوجى فى مصر .

يقول الأستاذ الدكتور علي محمد كامل :

ان العلاج يكمن فى توجيه الشباب المقبل على التعليم الهندسي نحو النوع الذى يوافق قدراته الذاتية ـ وهو لن يقبل هذا التوجيه عن طيب خاطر وينجح فى تنمية قدراته الا اذا تبين أن وضعه الوظيفى والاجتماعى لن يضار باختياره نوع التعليم الذى يوافق قدراته وأن فرص التقدم فى أى من التخصصين تعتمد فقط على مجهوده الشخصى .

وتنفيذ هذا العلاج جذريا يحتاج الى تنفيذ خطة بعيدة المدى قد تتخطى الجيل الحالى : وهى تبدأ بتطوير التعليم الأساسى بحيث يبنى على تحصيل المعلومات بجانب اكتساب السلوكيات والمهارات التى تمكن الطالب أو الطالبة من الاختيار بين اقتحام الحياة المنتجة مباشرة أو تؤهلها للالتحاق بمرحلة أخرى من الاعداد المتخصص بناء على ما يكتشف لديهما من قدرات ذاتية . ويتطلب الأمر كذلك اعادة النظر فى كيفية انتقاء واعداد أعضاء هيئات التدريس الهندسى واعادة فتح ابواب المنافسة بينهم لتتاح لهم فرص صقل قدراتهم واكتساب الخبرة فى نوع التعليم الذى يتجه كل منهم الى مزاولته .

والى أن تنفذ الخطة بعيدة المدى وتؤتى ثمارها فان هناك سبيلا قريب المنال يتناول آلاف الخريجين والخريجات من مختلف الكليات والمعاهد الهندسية يعتمد على قيام الصناعة مباشرة بدور فعال فى اعداد هؤلاء لتحمل المهام المنتظر أن يقدموا بها لدعم العمل الهندسى وتكامله .

وهذا السبيل ليس جديدا ايضا على مصر فهو مطبق فى حالات خريجى وخريجات التعليم الطبى الذين يقضون سنة امتياز يزاولون فيها المهنة تحت اشراف ومسئولية ذوى الخبرة بمجال تخصصهم ، كما أن خريجى وخريجات التعليم الهندسى الذين يعينون فعلا فى بعض مواقع القطاع العام يعد لهم برنامج تدريبى لمدة سنة أو سنة ونصف يغطى أقسام وادارات الموقع الانتاجى الذين يعينون فيه بحيث تتكون لديهم فكرة متكاملة عن مساهمة هذه الاقسام والادارات فى المنتج النهائى ويمارسون العمل فى كل منها لاكتساب السلوكيات الهندسية والمهارات الذهنية واليدوية التى تصقل اعدادهم .

وخلال هـذه المرحلة التدريبية الميـدانية يتبين للمشرفين على التدريب نوعية القدرات الذاتية للخريج أو الخريجة واستعدادهم للعمل فى مجال التطوير والتصميم أو فى مجال التنفيذ والتنظيم، وحينئذ يتقدم بشهادة المشرفين لنقابة المهندسين فتمنحه على أساسها ترخيص مزاولة المهنة على مسئوليته ويستكمل تأهيله كمهندس أو مهندسة فى مجال التخصص الذى يناسب قـدراته أو قدراتها ويعود بالفائدة عليه وعلى موقع عمله .

ويقول الأستاذ الدكتور محمد فهيم صقر :

لعل فشل التجارب السـابقة والخاصـة بالمعاهد التكنولوجية يرجع الى عدم وجود هيئات التدريس الواعيـة باحتياجات الصـناعة من الناحية التنفيـذية والعملية حتى يمكن تهيئـة الدارس فى الاتجاه السليم .

ولعل اكبر صعوبة هو أن هيئات التدريس بكليات الهندسـة تم تكوينها عن طريق اعـداد البحوث ـ أساساً نظرية ـ للحصول على درجة الماجستير والدكتوراه ، ثم نشر بحوث ـ اساسا نظرية أيضا ـ فى المجلات العلمية .

وللتغلب على هذه الصعوبة يجب ان يعـاد النظر فى طريقة اعداد أعضـاء هيئات التدريس بكليات الهندسة بالجامعات المصرية بحيث يعمل الخريج فى مصنع أو مؤسسة أو ادارة هندسية سنة أو سنتين على الأقل قبل تعينه فى وظيفة معيد ، وتشجيع تنقل أعضاء هيئات التدريس بين الجامعة ودور الصناعة ، ولا يعين استاذا فى الجامعة من لم يشغل وظيفة رئيسية فى مجال هندسى انشائى أو صناعى .

ويؤخذ فى الاعتبار عند ترقية عضـو هيئة التدريس الاعمال الانشائية التى قام بها وقدرته على الترشيد .

ومن المفارقات أن خريج كلية الهندسة الذى يطلق عليه لقب ((**مهندس**)) تخـرج على أيدى ((**علماء**)) وليسـوا ((**مهندسين**)) وليس من المقصود من هذا تقليل قيمة العلم بل ايجاد توازن بين العلم والتكنولوجيا فى التعليم الهندسى .

ويقول الاستاذ الدكتور أحمد خالد علام .

ان التطور السريع فى مجال العلم والتكنولوجيا الذى هو سمة هذا العصر ـ قد نتج عنه بعض الظواهر منها : اتساع المجالات المختلفة ضمن التخصص الواحـد بسرعة وبمعـدلات عالية ، ووجود تداخل مسـتمر ومتزايد بين فـروع التخصصات التقليدية ، وظهور مشكلة التقادم السريع للمعلومات الملحة والضرورية .

ويمارس المهندسـون خريجو الجامعـات أعمالا عديدة تمثـل مجالات عريضـة ضمن التخصص الواحد ، ويلاحظ أن التخصص الضيق فى مراحل التعليم الاولى مع وفرة المعلومات فى مجال هذا التخصص لا تسـاعد المهنـدس على مجاراة التطوير السريع والمتزايد ، ولكن الثقافة العلمية والهندسية الواسعة هى التى تجعـل المهندس اكثر مـرونة وقـدرة على مواجهـة الظـروف الجـديدة التى تعترض طـريقه باستمرار .

ويمكن تحقيق ذلك بتزويد طلبة كليـات الهندسة بقاعدة عريضة من العلم والمعرفة بجانب العلوم الاساسية والهندسية وذلك عن طـريق رفع نسبة العلوم الانسانية التى يدرسها الطالب من ٥ أو ٧ ٪ الى ٢٠ أو ٢٥ ٪ ، يدرس فيها الطالب اللغات والقـانون والاقتصـاد والادارة وغيرها من العلوم الاجتماعية والاقتصادية .

وفى نفس الوقت يجب التركيز والاهتمـام بالنواحى التكنولوجيا التى تحتاج الى قاعـدة علمية هندسية ادارية صلبة ـ وادخال ـ بعض المقررات التكنولوجية بكليات الهندسة وان تكون مسئولية هذه الكليات : الجناح الهندسى العلمى والجناح التكنولوجى .

ومما لا شـك فيه ان رفع نسـبة العلوم الانسانية وادخال مقررات تكنولوجية جـديدة ستؤثر على خطط الدراسـة المشحونة بالعلوم الاساسية والهندسية والهندسـية التطبيقية ، والتى لا تسمح باضافة مواد جـديدة سـواء انسانية أو تكنولوجية .

ولعلاج ذلك يجب ان تتجه الدولة الى جعل شهادة البكالوريوس فى الهندسة شهادة علمية ـ تسبق الشهادة الهندسية الاولى وهى درجة الماجستير .

فبعد حصول الطالب على درجة البكالوريوس فى الهندسة فى اى فرع : مدنى ـ عمارة ـ كهرباء ـ ميكانيكا ... يتم توجيهه (حسب ميوله وقدراته واتجاهاته) عند التحضير لدرجة الماجستير : اما الى البحث العلمى أو الى ممارسة مهنة الهندسة ، بحيث يستطيع الراغبون فى البحث المزيد من العلوم النظرية الهندسية ، والراغبون فى مزاولة المهنة التزود من العلوم التكنولوجية ، أى يكون هناك منهاجان لدرجة الماجستير .

* منهاج علمى يهدف الى تمكن الطالب لاستكمال الدراسات العليا والبحوث .

* منهاج مهنى يهدف الى تمكن الطالب من ممارسة المهنة .

والخلاصة ان تاريخ مصر الحديث حافل بايمان الدولة بمهندسى التنفيذ والتصنيع والتى قامت على أكتافهم النهضة المعمارية والانشائية والصناعية والبترول والرى فى الثلاثينيات والاربعينيات والخمسينيات من هذا القرن والذى تخرجوا من المعاهد العليا الصناعية (التكنولوجية) الا ان هؤلاء المهندسين كانوا دائما غير راضين عن وضعهم الاجتماعى لأنهم كانوا يشعرون بعدم مساواتهم بزملائهم المهندسين خريجى الجامعات كما ان المجتمع المصرى كان دائما غير راضى عن هذه التفرقة ، وسرعان ما كانت تتحول هذه المعاهد بين يوم وليلة الى كليات هندسة جديدة غير كاملة فى جامعات جديدة دون أن يسبقها اى دراسة أو تجهيز .

لهذا يجب أن تكف الدولة عن انشاء هذه المعاهد التكنولوجية التى تعرقل عملية التقدم الهندسى فى مصر لأنها ستتحول بعد فترة طالت أو قصرت الى كلية هندسية ذات مستوى متواضع تأخذ سنين طويلة حتى تستكمل مقوماتها وتصبح ذات مستوى مقبول .

وان يكون توفير فئة المهندسين التطبيقيين (التكنولوجيين) عن طريق كليات الهندسة نفسها (بعد تطويرها) وان تكون مسئولية هذه الكليات تخريج :

* المهندس العلمى للبحث والتطوير والتصميم والتخطيط .

* المهندس التكنولوجى للتصنيع والتطبيق والتنفيذ .

بعض توصيات ندوة تطوير التعليم الهندسى ابريل ١٩٨٧

جاء بتوصيات هذه الندوة أن التعليم الهندسى يهدف فى نهايته الى تخريج مهندس المستقبل يستطيع بعد التدريب الكافى أن يسهم فى تحقيق خطة الدولة للتنمية فى مجال التخصص ، ولتحقيق ذلك ينبغى :

١ ـ ربط التعليم الهندسى بالصناعه عن طريق خلق الحافز لدى الصناعة لحل مشاكاها وتطوير تكنولوجيتها وذلك : بانشاء وحدات للبحوث والتطوير بالمنشآت الصناعية الكبرى او وحدات مركزية قطاعية للمنشآت الصغيرة على ان يقوم بالبحث فيهما والتجارب فريق مشترك من رجال الصناعة والجامعات ـ وكذا انتهاج اسلوب شراء حق المعرفة للتصنيع ثم استخدامه لاكتساب الخبرات الاساسية ثم العمل على تطويره محليا بعد ذلك بالمشاركة من رجال الصناعة والجامعات .

٢ ـ الاهتمام بالتعليم الهندسى التكنولوجى (والتطبيقى) وذلك عن طريق دارسة المتطلبات القومية لاعداد وتخصصات ومستويات المهندسين التطبيقين والاهتمام بفتح قنوات جديدة للتعليم الهندسى التكنولوجى .

٣ ـ ادخال المواد الانسانية والبيئية وعلوم الفضاء ضمن برامج ومناهج التعليم الهندسى حتى ينهى الخريج دراستة بالكلية وهو على وعى كامل بمشاكل مجتمعه واحتياجاته وله القدرة على اختيار التكنولوجيا الملائمة لها ، وتتسم تصميماته الهندسية بالتوافق معها .

٤ ـ الاهتمام بالتربية الهندسية المستمرة بما يحقق تطوير المعارف والمهارات وسلوكيات المهندس اثناء عمله بما يتفق مع التقدم العلمى والتطورات التكنولوجية فى ظل التغيرات الديناميكية السريعة .

سيناء ـ منطقة حرة

تعتبر تنمية سيناء وتعميرها مطلبا من المطالب القومية لاستغلال امكانياتها الاقتصادية العديدة وحل مشاكل التكدس السكانى فى وادى ودلتا النيل .

تبلغ مساحة سيناء ٦١٠٠٠ كيلو متر مربع تمثل حوالى ١/٦ سدس مساحة مصر وثلاثة اضعاف مساحة الدلتا ، وتمتد سواحلها بطول ٧٠٠ كيلو متر اى ٢٩٪ من طول سواحل مصر ، ومحاطة شمالا بالبحر المتوسط وغربا بقناة السويس وخليج السويس وشرقا بخليج العقبة .

بها البترول والنحاس والحديد والفحم واليورانيوم والمنجنيز والجرانيت والفوسفات والكاولين ورمل الزجاج علاوة على ثروة سمكية وامكانيات زراعية وسياحية .

وهى حلقة اتصال بين قارتى آسيا وافريقيا وتعتبر بوابة مصر الشرقية ، دخل عن طريقها الغزاة : الهكسوس والفرس والاسرائيليون ، وعبرتها جيوشنا بالتالى للقضاء على الاعداء على أرض فلسطين والشام وهى منطقة الدفاع الرئيسية عن مصر من ناحية الشرق .

وقد ناقش مجلس الشورى مؤخرا تقريرا أعدته لجنة الانتاج والطاقة والقوى العاملة بالمجلس حول تنمية سيناء ، يقترح التقرير تحويل سيناء الى منطقة حرة ، ويقوم الاقتراح على أساس ان سيناء تشكل موقعا ممتازا لقيام الصناعة والتنمية الاقتصادية ، ويدعم ذلك قربها من الدول العربية الشقيقة وامكانية ربطها معها بشبكة من السكك الحديدية الى جانب توافر مقومات السياحة من شواطىء وجبال .

وقد ادى ذلك الى اثارة نوع من الجدل حول اقتراح المنطقة الحرة ما بين مؤيد ومعارض ومتحفظ . **والسؤال الذى يفرض نفسه هو على أى اساس يبنى كل طرف رأيه ؟ خاصة انه يوجد اتفاق عام على ان تنمية سيناء اصبح امرا حيويا .**

* السيد المهندس / حسب الله الكفراوى وزير الاسكان والتعمير :

أعلن سيادته تحفظه على ما ينادى به تقرير لجنة الانتاج والطاقة بتحويل سيناء الى منطقة حرة ، مشيرا الى ان دواعى الأمن القومى المصرى تقتضى الدراسة المتأنية لأية مشروعات يتم تنفيذها فى سيناء ، نظرا لحساسيتها الشديدة على مستوى الأمن القومى المصرى ، واستراتيجية موقعها باعتبارها بوابة مصر الشرقية ، وطالب المهندس الكفراوى بعدم التسرع فى الأخذ بهذا الاقتراح ، مؤكدا أن وزارة الاسكان والتعمير حريصة على تعمير سيناء وربطها بالوادى ، وعرض سيادته مجموعة من الدراسات مؤكدا انها تتضمن كل معلومة يمكن أن يطلبها المرء بشأن تنمية سيناء .

وقال سيادته **انه يجب ان يقتصر الاستثمار فى سينا على المصريين فقط اما المستثمر الاجنبى فيمكن ان يذهب الى اى مكان آخر فى القاهرة او الاسكندرية ...**

ويمكن فى هذه الحالة **تشجيع المستثمرين** المصريين وتقديم المساعدات اليهم وذلك باعلان شبه جزيرة سينا **مجتمع جديد** يخضع لقانون المجتمعات الجديدة (**بعد تعديله**) حتى تستفيد من مزايا هذا القانون من أعفاءات جمركية وضرائبية وتخفيض فوائد قروض تمويل المشروعات الى ٣ ، ٤ ٪ وبيع الارض للمستثمر بسعر منخفض .

* السيد / امين الهويدى :

يقول سيادته أن :

سيناء هى منطقة الدفاع الرئيسية عن مصر من ناحية الشرق ، وتشكل المنطقة الحيوية للدفاع عن البلادالعربية وقناة السويس، وتوفر العمق اللازم لتوفير فترة انذار معقولة لأى هجوم عدوانى من ناحية الشرق ، وتسمح بتكوينها الجغرافى بتهيئة مسرح نموذجى للعمليات الحربية بما توفره من موانى ومناطق صالحة لانشاء المطارات المفتوحة والطرق العرضية والطولية هذا بالاضافة الى صلاحيتها لاقامة مستعمرات زراعية وصناعية ، كل هذا يوضح ويجسد أمامنا الاستراتيجية البالغة لسيناء .

وتحويل سيناء ومنطقة القناة الى مناطق حرة لاستغلالها بواسطة رؤوس الأموال الأجنبية يعنى ان الرؤية الاقتصادية (ان تحققت) تسبق الرؤية القومية وبهذا يتهدد الأمن القومى المصرى .

وخطورة سيناء كانت وراء المحاولات الاستعمارية المستمرة لفصلها عن مصر وخاصة بعد حفر قناة السويس ، فقد حاول ذلك فردناند ديليسبس الذى كان وراء حفر قناة السويس ، حيث كان يحلم بان تكون شركة قناة السويس صورة عصرية لشركة الهند الشرقية البريطانية والتى قامت عليها الامبراطورية فى الهند وآسيا .

والمنطقة الحرة بسيناء أو القناة ستوجد بالضرورة مصالح أجنبية تكون وسيلة ضغط ـ شئنا أم ابينا ـ على القرار الوطنى .

فالاستعمار الاقتصادى ومحاولات فرض التبعية ليست بدعة مضى عليها الزمن ، والمشاركة والاعتماد المتبادل بين اطراف غير متكافئة خطر محقق،ولعلنا نذكر ان مجرد تأميم قناة السويس وهى شركة مصريةبحكم قوانينانشائها كانتسببا فى العدوان الثلاثى ١٩٥٦ ، وان سحب القوات الدولية من اماكنها فى سيناء أفسح الطريق الى حرب ١٩٦٧ .

وعلينا ان نلاحظ أنه منذ فجر التاريخ القديم أن التهديدات الخارجية لأمننا القومى كانت تأتى من ناحية الشرق ـ وأن سيناء منذ القدم كانت معبر للانبياء كما كانت معبرا للغزاة الذين وفدوا الينا ليجربوا حظهم .

﴿ الدكتور / أحمد أبو اسماعيل وزير المالية الأسبق :

يقول سيادته أن :

اقتراح تحويل سيناء الى منطقة حرة اقتراح جدير بالدراسة ، لأن له من الأسس ما يؤيده ، كما أن التخوفات المطروحة بها مجال للأخذ والرد ، ويذكر سيادته أنه لا يوجد ما يختلف على أن تنمية سيناء أمر ضرورى ، فسيناء سكانها قليلون ، كما ان بها من الموارد مايتطلب استغلاله الى جانب وجود أراضى كثيرة لابد من استصلاحها ، وهنا فان استثمار هذه الموارد يتطلب مئات الملايين من الدولارات ، والسؤال الذى يثار كالتالى : اذا كنا نريد تنمية سيناء ، فهل نستطيع بمواردنا المحدودة القيام بهذه المهمة ؟ هنا يبرز اقتراح المنطقة الحرة ، ويجب الا يرفض لمجرد الرفض ، فكيف نجذب رأس المال الأجنبى الى الاستثمار فى مصر ، وعندما يظهر مجالا لذلك أقول له : لاتجىء ..!

ثم ان وجود مستثمرين أجانب فى منطقة مثل سينا سيقوى موقفنا امام الدول الأخرى ، ويكون حماية لنا .

اما اذا كان البعض سيعترض بذكر المنطقة الحرة فى بورسعيد ، فان لكل منطقة ظروفها الخاصة بها ، وبورسعيد لم توجد بها الامكانيات التى تساعدها على اقامة صناعات تصديرية ، كما ان جعلها منطقة حرة لم يقترن باعداد خطة تنمية لها .

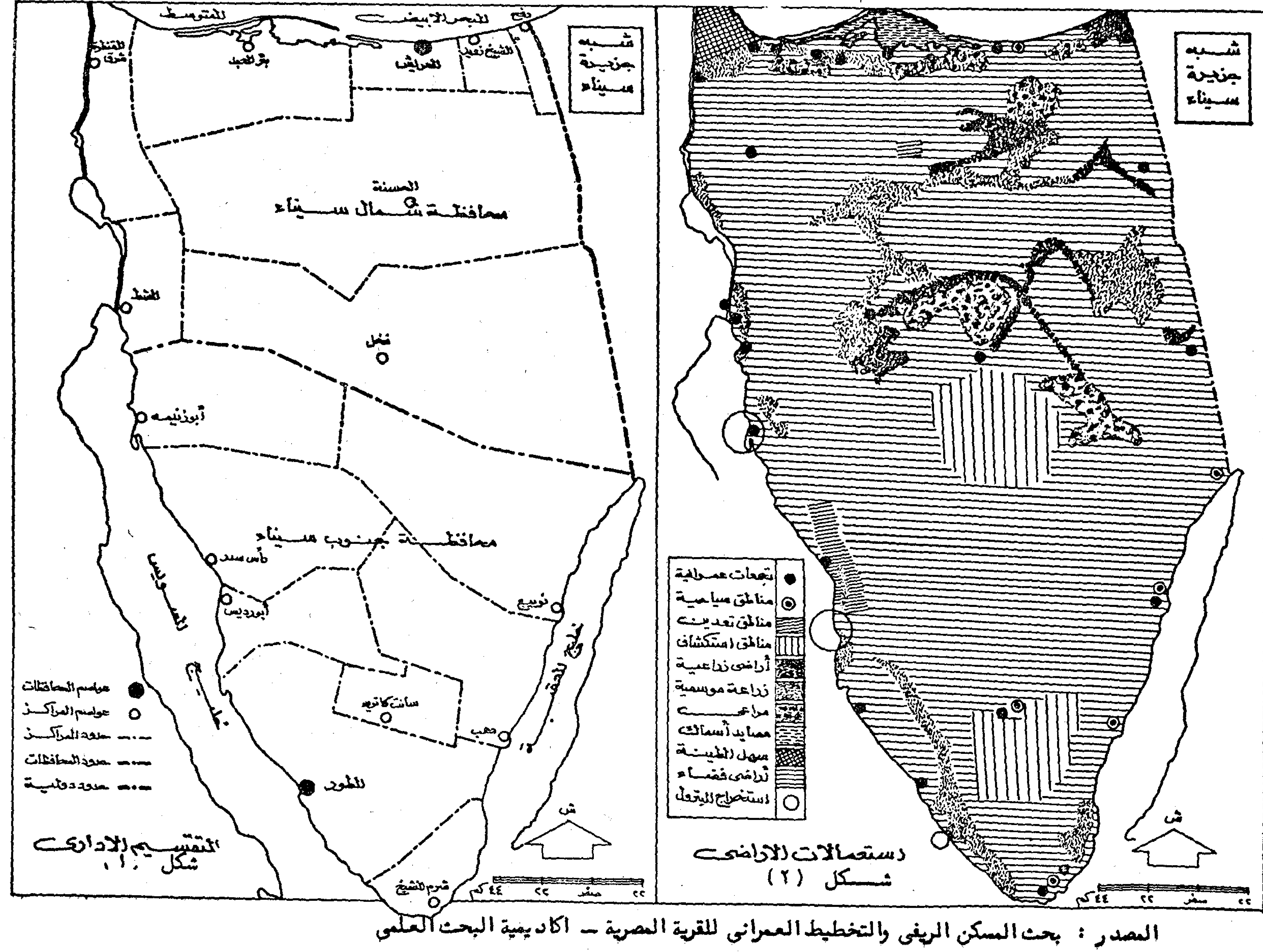
اما بالنسبة للاعتبارات الامنية التى ترد على هذا الاقتراح ، فان الرد على هذا باننا يجب ان نكون أقوياء فى كل نقطة سواء على الحدود أو غيرها بحيث نستطيع ان ندافع عن أراضينا ، ويجب ان يفهم الجميع أن مصر ستكون من القوة بحيث لن يستطيع أحد ان يخترقها ، وفى ظل هذا الوضع فاننى أؤيد انشاء منطقة حرة فى سيناء لانها ستمكننا من استغلال امكانيات سيناء كما ستوفر فرص عمل عديدة للشباب ، ولك أن تتصور انه مطلوب تشغيل ٤٠٠ الف شخص سنويا يتكلفون ٢٠ مليار جنيه فمن أين تأتى مصر بهذه المليارات ؟

﴿ الأستاذ الدكتور طاهر الصادق ـ وكيل معهد التخطيط العمرانى :

يقول سيادته انه :

يمكن لراس المال العربى والخبرة الأجنبية أن تشارك فى تنمية سيناء ، بشكل مكثف بحيث يمكن جنى ثمار هذا الاستثمار فى فترة زمنية ليست ببعيدة ، ومن ثم مشاركة هذا الاقليم (سيناء) مع الدولة فى التخفيف عن المشكلة التى تعانى منها البلاد ، وقد تكون هذه المشروعات استصلاح أراضى خاصة فى السواحل الشمالية .. أو مصادر تعدينية .. أو ثروات طبيعة، ثم التحقق منوجودها بالكميات والنوعيات الاقتصادية الكفيلة بانشاء ودوام مشروعات ذات عائد مالى اقتصادى محقق ، وقد تكون هذه المشروعات سياحية على الشواطىء الشمالية والجنوبية لسيناء ، وقد تكون صناعات تقوم على مصايد الاسماك والصناعات البترولية .

ويضيف الدكتور الصادق بأن هذه المشروعات كلها ممكن ـ بعد دراسات الجدوى الاقتصادية لكل مشروع ـ طرحها على السوق العالمى والعربى فى شكل خريطة للاستثمار ، وتعمل الدولة من جهتها على تذليل كل العقبات، وعند ذلك تكون هناك ضوابط قانونية وتمليكية وامنية ، على الا تكون هذه الضوابط معوقات أو مصدر قلق وهرب راس المال الأجنبى ، بقدر ما تكون عوامل أمان وطمأنينة لراس المال الأجنبى فى هذه المناطق الفريدة ، وخاصة بعد تزويد المناطق المختلفة للموارد المتاحة بشبكات البنية الأساسية اللازمة لها ، وان يصبح مشروع تنمية سيناء مشروعا قوميا ، ليس من مسئولية وزارة التعمير فحسب،وانما مسئولية الوزارات والهيئات المختلفة .

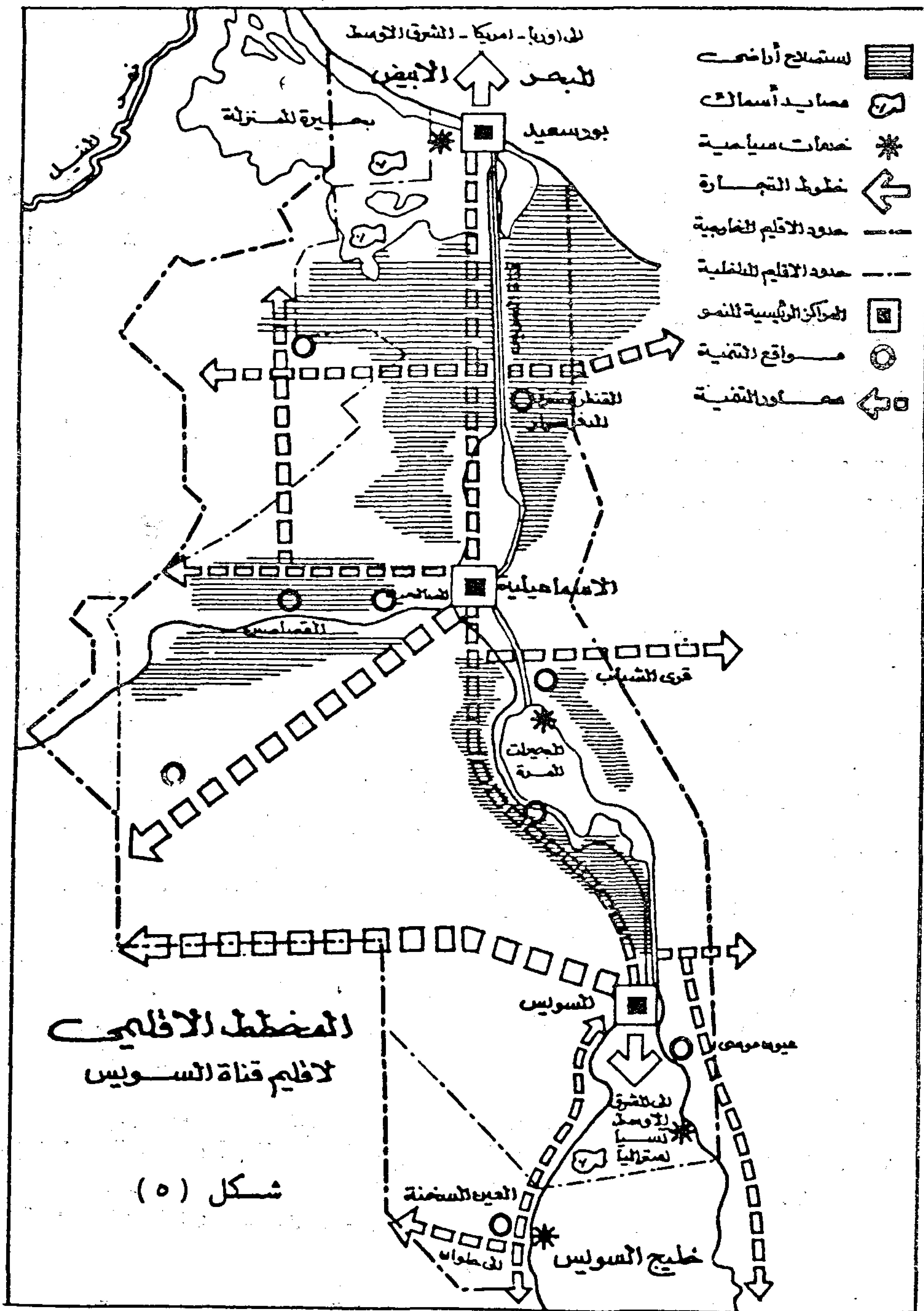


المصدر : بحث السكن الريفي والتخطيط العمراني للقرية المصرية – اكاديمية البحث العلمي

شكل (٣) الثروات الطبيعية

شكل (٤) المخطط المقترح

المصدر : بحث السكن الريفى والتخطيط العمرانى للقرية المصرية / أكاديمية البحث العلمى



شكل (٥)

المصدر : بحث المسكن الريفى والتخطيط العمرانى للقرية المصرية أكاديمية البحث العلمى

أما لماذا نلجأ الى الاستثمارات الأجنبية فى تنمية سيناء ، فاننا اذا نظرنا للخطة المالية للدولة ، نجد أنها تعتمد على ٦٠٪ من جانب الدولة و٤٠٪ من القطاع الخاص ، وهذا يؤكد أن أهداف الخطة القومية المعلنة حاليا لا يمكن للدولة أن تقوم بتنفيذها وحدها ، اما القطاع الخاص الوطنى فيمكن ان يشارك فى التنمية : اما بمشاركة وطنية بحتة واما من خلال مشاركة رأس المال العربى والأجنبى .

ويتساءل الدكتور الصادق : لماذا التخوف ؟ ان الدولة نفسها تشارك فى مشروعات برأس مال عربى ، مثل مشروعات هيئة التصنيع العربى ،

ومصنع الحديد والدرفلة بالاسكندرية، ومصانع الغزل والنسيج بالمحلة وكفر الدوار ، وغيرها من المشروعات التى يزمع انشاؤها فى مجال الادوية وصناعات السيارات ، ثم لنسأل أنفسنا لماذا تختلف سينا عن غيرها من تراب الوطن ؟ فحكم سيناء مثله مثل مرسى مطروح والواحات وأسيوط والقاهرة .

واذا كانت هناك تخوفات أمنية بالنسبة لسيناء فمثل هذه التخوفات لابد ان تنطبق على القاهرة والاسكندرية وغيرها ، فيجب أن نغير ذاكرتنا عن سينا بأنها ليست سوى منطقة حروب ، ونجعل سيناء للتنمية ، كما جعلنا أسوان التى كانت فى وقت من الأوقات منفى للموظفين المصريين المشاغبين وحققت تنميتها مكانة عالمية .

❋ الأستاذ الدكتور احمد خالد علام

يقول سيادته :

أولا : سكان شبة جزيرة سيناء فى تعدادى ١٩٦٠ ، ١٩٦٦ كان ١٢٥ ، ١٣١ ألف نسمة على التوالى ، ومنذ تحرير سيناء منذ ثمانية سنوات وحتى الآن بذلت الحكومة جهودا كبيرة فى مجال العمران والتنمية الاجتماعية والاقتصادية ، ورغم كل هذه الجهود فلم يزد عدد سكان سيناء عن ٢٠٠ الف نسمة (حسب تعداد ١٩٨٦ : ١٧١ الف شمال سيناء ، ٢٩ الف جنوب سينا) ، ويدل ذلك على ان الأمر يحتاج الى وقفة واعادة النظر فى أسلوب التنمية للاسراع فى عمليات التعمير وتنمية الموارد المحلية ولا سيما ان الشعب يضع امالا كبيرة على سيناء لنقل جزء من الكثافة السكانية من الوادى اليها.

ثانيا : يقول جمال حمدان فى الجزء الثالث من كتابه (شخصية مصر) أن العمران فى مصر يجب ان يتجه شرقا ــ سواء فى الوادى أو الدلتا ــ وبالنسبة لشرق الدلتا فينحصر مثلث صحراء شرق الدلتا من قناة السويس شرقا وطريق القاهرة السويس الصحراوى جنوبا وتخوم المعمور فى محافظات الدقهلية والشرقية والقليوبية غربا ، وكان هذا الفراغ هو الذى أطمع العدو وأغراه بالعبور ، فكانت الثغرة المأساوية فى حرب أكتوبر ، لذلك يجب على الفور ملء هذه الفجوة ، وبغير ان ينتظم العمران والاستصلاح والزراعة فى هذه المنطقة فلن يكون جديا ولا مجديا تعمير منطقة قناة السويس ولا سينا من بعدها ، فانها قاعدة الأساس وأساس الانطلاق الى الشرق » .

ثم ان تعمير منطقة القناة ــ الضفة الشرقية ــ سيكون نقطة ليزحف الاستصلاح والتعمير اماما الى سيناء ، وانها لخرافة ساذجة ان نتطلع الى تعمير سينا كحاجز استراتيجى ضد العدو دون ان تتحول منطقة القناة نفسها أولا الى قاعدة بشرية عمرانية زراعية كثيفة جدا ، فهذا شرط أول وأولية شرطية لتلك ، واختصارا قناة السويس احادية الضفة عمرانيا وقد وجب الآن ان تزدوج .

ثالثا : مسألة تحويل شبه جزيرة سيناء بأكملها الى منطقة حرة أمر يحتاج الى دراسة شاملة مستفيضة تأخذ فى حسبانها كل الاعتبارات الاقتصادية والاجتماعية والطبيعية والبيئية والعمرانية والسياسية والامنية .

ولكن ممكن فى هذه الفترة تحويل منطقة الضفة الغربية لقناة السويس الى منطقة حرة كوحدة اقتصادية متكاملة ، تمتد هذه المنطقة من بور سعيد شمالا حتى السويس جنوبا وبعرض مناسب يحدده خبراء التخطيط والجغرافيا والاقتصاد ورجال الأمن الداخلى والخارجى ، وقد يصل هذا العرض (العمق داخل سينا) الى ٢٠ أو ٣٠ كيلو متر أو حتى الى المرات .

((تنمية الصحراء المصرية فى اطار من التخطيط الاقليمى)) *

دكتور مهندس / سمير سعد على **

فى محاولة لدراسة تنمية الصحراء فى اطار من التخطيط الاقليمى أصبح من الضرورى تقييم تقسيم جمهورية مصر الى أقاليم تخطيطية وتطبيق نظام التخطيط الاقليمى بشكل صحيح وذلك وصولا الى الأهداف التالية : —

— تحقيق التكامل بين المجتمعات العمرانية القائمة ومناطق الامتداد العمرانى بالصحراء المصرية والخروج اليها وتنميتها واستغلال مواردها الاقتصادية والطبيعية هذا بالاضافة الى تحديد حجم مناسب للسكان بها فى اطار تخطيط شامل .

— استغلال الموارد الأرضية وتوسيع الحيز المكانى واستغلاله أحسن استغلال وترشيد استخدامات الحيز المكانى والذى يعتبر عنصرا من عناصر التنمية .

— تخفيف الضغط السكانى على الوادى والدلتا واعادة توزيع السكان والانشطة بها .

— حل مشكلة الفوارق الأقليمية وتحديد وظائف كل اقليم ومراحل التنمية التى يمر بها .

— تأكيد قوة الحكومة وقيامها بوظائفها الادارية المختلفة .

ولقد أثبتت التجربة أن تقسيم مصر الى أقاليم تخطيطية قابلة لكثير من المشاكل والمعوقات جعلت التجربة لم تدخل فى حيز التنفيذ .

واذا كانت عمليات التنمية تواجه كثيرا من المشاكل فى غياب من التخطيط الاقليمى حيث تعتبر اداة من الأدوات التخطيطية لحل المشاكل المكانية بل انه أداة من أدوات تنفيذ الخطة القومية بصورة اكثر كفاءة وقدرة على تحقيق الأهداف القومية على نحو شامل .

لذا وجب العمل على رسم الخطوط العامة لدفع عملية التخطيط الاقليمى وتقسيم مصر الى أقاليم تخطيطية وصولا لتنمية الصحراء المصرية فى الاطار الاقليمى السليم .

ولقد شملت الدراسة النقاط المبينة التالية :

١ — مفهوم التخطيط الاقليمى :

بهدف التعرف على أهمية العمل بالتخطيط الاقليمى واعتباره الأسلوب الأمثل .

٢ — مستهدفات التخطيط الاقليمى وضرورياته

بهدف التعرف على أهمية الأخذ بالتخطيط الاقليمى والعمليات المستخدم فيها وكيفية تطبيقها وأهدافها .

٣ — التخطيط الاقليمى وتجارب دول العالم :

بهدف التعرف على مدى ما حققته الدول الدول وكيفية تحديد الأهداف وأساليب التقسيم .

٤ — التخطيط الاقليمى فى مصر ومشاكله التطبيقية :

بهدف تقييم التجربة (سلبياتها وايجابياتها) ثم كيفية تحديد سياساتها وممارساتها ودفعها لتنمية المساحات الشاسعة من صحراء مصر واستغلال موارد البلاد وتحقيق تكامل اقليمى على درجة أعلى من التجانس وتحقيق درجة أعلى فى التنظيم المكانى .

التخطيط الاقليمى ، أهميته وأهدافه وأساليبه

التخطيط الاقليمى ((أسلوب يأخذ فى الاعتبار البعد المكانى ، ويتأثر بعناصر الموارد الانتاجية المتاحة، وبالناحية الزمنية، بالامكانيات التنظيمية والادارية على المستوى المحلى بقصد تنميتها بأعلى معدل ، وبأدنى تكلفة ، وفى اقصر وقت بحيث يتحقق — بناء على ذلك أعلى معدل تنمية قومى، تذوب فيه الفوارق بين المستويات الاجتماعية والاقتصادية .

هذا بالاضافة الى أن عملية التخطيط الاقليمى تنظم العلاقة بين البيئة والانسان ولا يكتفى بذلك بل يسعى ايضا الى تطوير هذه البيئة حتى تتمشى مع مطالب المجتمع .

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* ملخص البحث الذى عرض فى المؤتمر الرابع لاتحاد المعماريين المصريين ٥ — ٧ ابريل ١٩٨٨ القاهرة .

** عضو هيئة التدريس — قسم التخطيط — كلية الهندسة — جامعة الازهر .

والتخطيط الاقليمى فى اطار التخطيط القومى يمكن ان يحدد الأنشطة الاقتصادية والخدمات العامة وينظم حركة العمران داخل الاقليم ويخلق مناطق جذب حضرية تساعد على الحد من الهجرة الى المدن الكبرى .

أولا ــ الأهداف العامة لعملية التقسيم الى أقاليم تخطيطية :

● أن عملية التقسيم ليست هدفا فى حد ذاتها ولكنها أداة لتحقيق أو تسهيل أداء مجموعة من الوظائف والمهام ، أو تسهيل وضع حلول لمجموعة من المشاكل أو لتحقيق مجموعة من الأهداف المحددة . وعملية التقسيم بالمعنى السابق تعتبر عملية متعددة الأغراض أوالأهداف كما أنها تتم طبقا لمجموعة من المعايير وطبقا لمنهجية وأساليب معينة بالاضافة الى ضرورة تحقيق أهداف متفق عليها مسبقا .

● لا تختلف مستهدفات الخطة الاقليمية فى كثير منها ، عن الأهداف الرئيسية للخطة العامة للدولة ، فالهدف فى الاثنين واحد وهو احداث التنمية الاقتصادية والاجتماعية فى المجتمع موضوع الخطة . واذا كان هناك اختلاف بين هذه وتلك ، فان ذلك يرجع الى الاطار المكانى المحدود الذى تتحرك فيه الخطة الاقليمية ، ويحدد بالتالى أهدافها .

وضروريات التخطيط الاقليمى تتضح مما يلى :

١ ــ أحداث حالة من التوازن الاقتصادى والاجتماعى بين اقاليم بعضها البعض .

٢ ــ تغيير الهيكل الاقتصادى للاقليم ورفع مستوى دخل الفرد فيه .

٣ ــ خلق فرص العمل ، والتقليل ما أمكن من هجرة الطاقات البشرية الى خارج الإقليم .

٤ ــ توفير أكبر قدر من الخدمات الاجتماعية والخدمات العامة للاقليم .

٥ ــ تحقيق الاستغلال الأمثل للموارد الاقليمية المتاحة .

٦ ــ النهوض بالبيئات المحلية صناعيا وزراعيا .

٧ ــ تحقيق درجة أعلى من التنظيم المكانى .

٨ ــ تأكيد قوة الحكومة وقيامها بوظائفها الادارية المختلفة .

٩ ــ تحديد وظيفة كل اقليم ومرحلة التنمية التى يمر بها .

١٠ ــ تصنيف طرق استخدام الأرض .

ثانيا ــ المشاكل التى تواجه الحيز المكانى المصرى:

بدأ اتساع درجة الفوارق بين اقاليم مصر المختلفة بالذات خلال فترة الستينيات حيث ركزت الخطة الخمسية الاستثمارات الانتاجية والخدمات فى المناطق الحضرية وبالذات فى القاهرة والاسكندرية وقناة السويس بالاضافة الى أسوان حيث يوجد مشروع بناء السد العالى .

وقد استحوذت القاهرة والاسكندرية على سبيل المثال من برنامج التصنيع على حوالى ٥٠٪ من اجمالى الاستثمار الصناعى بينما استحوذت السويس وأسوان على حوالى ١٧٫٤٪ ١٣٫٨٪ من اجمالى الاستثمارات والباقى ٢٠٪ من اجمالى الاستثمارات تم توزيعه على ٢٠ محافظة. حقيقة قد تكون هناك أسباب اقتصادية خلف تركز الاستثمارات فى القاهرة والاسكندرية ولكن مهما كانت الأسباب كان من الواجب الأخذ فى الاعتبار آثار هذا التركز على الحيز الجغرافى المصرى ككل .

كما تتضح الفوارق أيضا فى توزيع العمالة على المحافظات حيث أن ٥٠٪ من اجمالى العاملين بالقطاع العام الصناعى يعملون فى محافظتى القاهرة والاسكندرية بينما تحصل باقى المحافظات على ٥٠٪ من اجمالى العمالة خلال عام ١٩٧٧ ويضاف الى ذلك وجود مظاهر للتفاوت فى المستويات الاقتصادية والاجتماعية بين المحافظات المصرية .

وبالنظر الى الظروف الجغرافية يتضح انها أدت الى خلق نوعين من المجتمعات فرضت نفسها على الحيز المكانى المصرى هما المجتمع المأهول تقليديا والمناطق الصحراوية . هذا الوضع خلق نوع من الفوارق الفريدة يتميز بها المجتمع المصرى وجعل التركز السكانى على مساحة حوالى ٤٪ من اجمالى المساحة الكلية لمصر .

وعموما أدت الظروف السابق الاشارة اليها الى خلل فى الهيكل المصرى . بالاضافة الى ذلك أصبح النمط الحضرى فى مصر من النوع الذى يطلق عليه . « نمط سيادة وحدة حضرية واحدة » وقد يرجع سبب ذلك الى الآتى :

– تركيز للسكان فى شريط ضيق يبدأ من جنوب الوادى حتى بادية الدلتا حيث يتفرع النهر الى فرعين يحصر بينهما الدلتا التى تعتبر من أخصب أراضى مصر . وتمثل مساحة الوادى والدلتا وبعض المناطق التى أخذ السكان يتركزون فيها حوالى ٤٪ من المساحة الكلية لمصر . ويبقى بعد ذلك ما يقرب من ٩٦٪ من مساحة مصر خالية تقريبا من السكان الا من حوالى ١٪ تقريبا . وهذه المساحة الكبيرة ليست خالية فقط من السكان ولكن تعتبر الى حد كبير خالية من النشاط الاقتصادى والاجتماعى .

– تطور عدد سكان مصر فى الفترة من ١٩١٧ – ١٩٨٦ تطورا كبيرا اذ بلغ حوالى ١٣ر ، ١٤ ، ١٥ ، ١٩ ، ٢٦ ، ٣٦ ، ٥٠ مليون نسمة فى السنوات ١٩١٧ ، ١٩٢٧ ، ١٩٣٧ ، ١٩٤٧ ، ١٩٦٠ ، ١٩٧٦ ، ١٩٨٦ على التوالى .

– الخلل فى الهيكلى الادارى أدى تفاوت بين الاقاليم واختلاف مراحل التنمية الاقتصادية والاجتماعى بها .

– وجود أثر سياسى كبير لمدينة القاهرة والاسكندرية بالاضافة الى الآثار الاقتصادية والاجتماعية .

– ارتباك المخطط الأمر الذى أدى الى عدم وجود استراتيجية واضحة للتنمية الاقليمية .

– وجود خلل فى توزيع الهيكل الانتاجى بالاضافة الى وجود فوارق واضحة بين المحافظات بعضها البعض وبالذات بين المحافظات الحضرية والريفية .

– تعدد المشاكل التخطيطية فى المحافظات الحضرية نتيجة ارتفاع معدلات الهجرة اليها .

● بالاضافة الى ما سبق اذا اخذنا فى الاعتبار الزيادة السكانية المتوالية مع الثبات النسبى للرقعة الزراعيةوعدم الاستغلال الرشيد للموارد الطبيعية المتاحة والحيز المكانى لاتضح لنا مدى المشكلة السكانية التى تواجهها مصر وبالذات فى ظل زيادة طبيعية مرتفعة .

لكل هذه الأسباب أصبح الأخذ بأسلوب التخطيط الاقليمى ضرورة لا تحتمل التأخير يكون هدفها الأول استغلال الحيز المكانى المصرى المتاح فى الصحراء وما تنتج من ثروات طبيعية يحقق نشاط اقتصادى متكامل يؤدى الى توزيع كاف للسكان على خريطة مصر هذا بالاضافة الى أهمية التخطيط الاقليمى لاستغلال ماهو متاح من موارد تنمية داخل الوادى والدلتا .

ثالثا – التخطيط الاقليمى من واقع القوانين المصرية :

فى عام ١٩٥٣ انشىء المجلس القومى للانتاج لتنمية الانتاج فى مجال الزراعة والتعدين والبترول والكهرباء والصناعات التحويلية وتحسين وسائل النقل والمواصلات وتنشيط التجارة .

وفى عام ١٩٥٤ انشىء المجلس القومى للخدمات العامة .

وفى عام ١٩٥٥ صدر قانون بانشاء لجنة التخطيط القومى .

ثم توالت التشريعات فى هذا المجال فصدرت القوانيين الآتية :

فى عام ١٩٥٩ قرار جمهورى بانشاء مكاتب تخطيط بالوزارات تعاون جهاز التخطيط القومى

وفى عام ١٩٦٠ قرار آخر بانشاء لجان تخطيط ومتابعة فى كل وزارة تختص بأعداد مشروعات الخطة العامة للسنوات الخمس والخطط السنوية .

أما فى مجال التخطيط الاقليمى ففى عام ١٩٦٤ بدأ التطبيق الفعلى له بصدور قرار جمهورى بانشاء مشروع اقليم أسوان .

وفى عام ١٩٦٥ صدر قرار جمهورى آخر بانشاء لجنة عليا لتخطيط اقليم القاهرة الكبرى.

وفى عام ١٩٧٣ الغى جهاز تخطيط القاهرة الكبرى .

وفى عام ١٩٦٦ صدر قرار جمهورى بانشاء لجنة عليا للتخطيط الاقليمى والعمرانى لمنطقة الاسكندرية .

أما فى عام ١٩٧١ تبنت الأمانة العامة للحكم المحلى فكرة المسح الشامل بالمحافظات للاستفادة منه فى أغراض التخطيط .

وتبعه فى عام ١٩٧٤ موافقة اللجنة الوزارية للحكم المحلى من حيث المبدأ على تقسيم مصر الى اقاليم تخطيطية وتشكلت لجنة برئاسة الدكتور/ فؤاد محيى الدين (رحمه الله) وزير الحكم المحلى وقت ذلك وقامت بدراسة وتجميع المحاولات التى بذلت لتقسيم مصر الى أقاليم تخطيطية .

وصدر القرار الجمهورى رقم ٤٧٥ لسنة ٧٧ بتقسيم مصر الى اقاليم اقتصادية ثمانية وهى :

ـ اقليم القاهرة :

ويشمل محافظة القاهرة ـ الجيزة ـ القليوبية .

ـ أقليم الاسكندرية :

ويشمل الاسكندرية ـ البحيرة ـ النوبارية .

ـ اقليم مطروح :

ويشمل محافظة مطروح وضم بعد ذلك الى اقليم الاسكندرية .

ـ اقليم شمال الصعيد :

ويشمل المنيا ـ بنى سويف ـ الفيوم ـ والجزء الشمالى من محافظة البحر الأحمر .

ـ اقليم أسيوط :

ويشمل أسيوط ـ الوادى الجديد .

ـ اقليم جنوب الصعيد :

ويشمل أسوان ـ سوهاج ـ قنا ـ الجزء الجنوبى من محافظة البحر الأحمر .

بعد صدور هذا القرار بالتقسيم ـ أنشأت وزارة التخطيط ثمانية وظائف بدرجة وكيل أول وزارة لرئاسة هيئات التخطيط .

على أن ينشأ بكل اقليم لجنة عليا للتخطيط يشرف عليها الوزير المختص بالحكم المحلى (الآن وزير الحكم المحلى تابع لرئيس مجلس الوزراء) محافظ الاقليم ـ محافظين المحافظات التى يتكون منها الاقليم ـ رؤساء المجالس المحلية ـ رئيس هيئة التخطيط الاقليمى ـ ممثلوا الوزارات .

وهنا تأتى التساؤلات الآتية :

ـ أين المخطط العمرانى ضمن هذه اللجان ؟

ـ هل حققت تجربة التخطيط الاقليمى فى مصر أهدافها ؟

ـ هل تم العمل بالتقسيم الاقليمى الصادر بالقرار الجمهورى لعام ١٩٧٧ ؟

والاجابة ـ وبعد ١٠ سنوات على صدور قرار التقسيم وتشكيل هذه الهيئات لم يظهر لها ولنشاطها شىء يذكر ـ بخلاف توزيع الاستثمارات على المستوى الاقليمى بدلا من توزيعها على مستوى المحافظات .

والغريب أن كثيرا جدا من اللجان لم تجتمع خلال العشرة سنوات الماضية الا مرات عديدة للتعارف وذلك للاسباب التالية :

ـ عدم وجود هياكل تنظيمية لهيئات التخطيط ذاتها .

ـ عدم وجود دور واضح لهيئات التخطيط الاقليمى بحيث يكون لها مسئوليات فى اجراء العملية التخطيطية وتنفيذ الخطط وفقدانها الى الأصول العلمية لعملية التخطيط .

ـ عدم وجود استراتيجية واضحة لمتطلبات التنمية بالمحليات تتفق مع الاستراتيجية العامة للدولة .

ـ اختلاط المفاهيم وعدم التجانس بين الأجهزة التنفيذية بالمحافظات وعلى رأسها المحافظ وبين هيئة التخطيط الاقليمى الذى يرأسها (وكيل وزارة) .

ـ عدم توفير البيانات والمعلومات التى تساعد على اجراء عملية التخطيط نفسها والأكثر من ذلك .

ـ فصل التخطيط العمرانى عن التخطيط الاقتصادى حيث اغفل نص القرار الجمهورى النواحى العمرانية ولا شك أن من أهم خصائص التخطيط الاقليمى الشامل هو أن يسير التخطيط الاقتصادى والاجتماعى جانبا الى جنب مع التخطيط العمرانى ـ بحيث يجب أن تظهر صورة تبين ما سيكون عليه الاقليم فى المستقبل وما يشمله من مراكز عمران وشبكة طرق واستعمالات أرض الاقليم ـ وبمعنى آخر يرسم رجل الاقتصاد خطوط المستقبل للانشطة الاقتصادية ـ ويرسم مهندس التخطيط الصورة المجسمة لمراكز العمران .

● كيفية تنمية الصحراء فى اطار التخطيط الاقليمى :

لتحقيق ذلك يجب :

١ ـ اعادة النظر فى التقسيم الاقليمى الحالى والعمل بشكل سريع على أن يقوم المخططين بدور فعال بالجانب الاقتصادى والاجتماعى على أن يكون ضمن هذا المخطط أهداف واضحة يجب تحقيقها وترسم لها السياسات التمويلية وأساليب التنفيذ بالاضافة الى البرامج الزمنية والأجهزة الادارية . ومن ضمن هذه الأهداف :

ـ استطلال وتعمير صحراء مصر ، على أن تشكل الصحراء محاور عرضية من الغرب الى الشرق تتكامل مع محاور التنمية الطولية الحالية من الشمال للجنوب (محور الوادى والدلتا) .

ـتكون الأولية فى عمليات التنمية خارج الوادى والدلتا للمناطق الصحراوية المتاخمة

للاراضي الزراعية على امتدد الوادى بالاضافة الى المناطق الصحراوية فى حدود محافظة الشرقية والبحيرة ومدن قناة السويس .

– استخدام الأساليب الخاصة بمواجهة مشكلات الاستيطان فى المناطق الصحراوية وايجد الطرق والأساليب المبتكرة لاستخدام التكنولوجيا الحديثة . واذا كانت التكاليف الاستثمارية عالية بدرجه كبيرة فى عمليات التنمية فى المناطق الصحراوية الا أنه على المدى الطويل يمكن تحقيق عائد استثمارى جيد وذلك بالتركيز على الجهد البشرى وباعتبره أحد عناصر التنمية الأساسية فى مثل هذه المجتمعات هذا بالاضافة الى مواجهة المعوقات والمتطلبات الخاصة بتوفير قدر أكبر من الكفاءة فى الآتى :

* ادارة موارد المياه واستخدام تكنولوجيا الزراعة والطاقة .

* وسائل المواصلات .

* انماط الاستيطان المتوائمة مع البيئة .

٢ – التقسيم الادارى الحالى ضرورة ضمن التخطيط الاقليمى وخصوصا فى مراحله الأولى وذلك لتحقق الآتى :

– عمليات تجميع البيانات وعمليات المسح الخاصة بالثروات الطبيعية .

– سهولة التنفيذ للتخطيط والمتابعة واستخدام الكوادر المتاحة بالمحافظات .

– يكون المحافظ مسئول داخل حدوده الادارية عم يكلف به من خطة .

٣ – ضرورة ان تكون هيئات التخطيط الاقليمى هيئات مستقلة ، قرارتها ملزمة وخطتها تخضع للسياسات العامة للدولة وفى اطار تخطيط قومى شامل وتعطى كافة الصلاحيات والامكانيات الفنية والمادية وتستعين بالأجهزة التخطيطية والاستشارية المختصة .

٤ – لكى تضمن سلامة التقسيم الاقليمى لمصر فى اطار من التخطيط الاقليمى يجب أن تتم بعض الدراسات الآتية :

أ – دراسة مناطق النمو الحالية والمحتملة مع بيان الأسس التى تم عليها تقدير الأهمية النسبية لتلك المناطق مستقبلا .

ب – دراسة المناطق الصحراوية من ناحية :

● الوصف الجغرافى لها .

● ارتباطها بالوادى والدلتا من الناحية الاجتماعية ومن الناحية الاقتصادية ومن الناحية الفيزيقية ومحاور التنمية .

● امكانياتها الطبيعية مع تحديد المناطق الصالحة لاجراء عملية التنمية ..

ج – دراسة مناطق الحدود على وجه الخصوص من خلال دراسة :

● أسلوب تنميتها .

● كيفية ربطها بالوادى والدلتا .

● استراتيجية تنيمتها فى اطار مدنى عسكرى .

د – دراسة المدن الحالية وطاقتها الاستيعابية المحتملة من ناحية السكان والأنشطة الاقتصادية ومشاكلها الحالية وامكانيات التوسع مع تحديد التكاليف الاقتصادية والاجتماعية لأى عملية توسع مستقبلية .

و – دراسة المدن الجديدة وعلاقتها بالمدن القديمة والحيز المأهول وامكانيات استيعابها للسكان والأنشطة الاقتصادية ومشاكلها والمدى الزمنى للوصول الى الطاقة الاستيعابية المخصصة .

ط – دراسة مناطق التكدس الصناعى وارتباطها بمناطق التركيز السكانى والتركيز على :

● ارتباط مناطق التكدس الصناعى بعضها ببعض .

● تحديد اقطاب ومراكز النمو .

ز – دراسة الوضع الاقتصادى المصرى فى الثمانينات والمشاكل التى تواجه التنمية القومية وذلك من خلال دراسة زيادة السكان والعمالة وعلاقتها بزيادة السكان ومستوى التوظف والانتاج هذا بالاضافة الى كفاءة اداء هيكل الاقتصاد القومى فى ظل الظروف الحالية ومستويات الاجور والاستثمارات المتاحة .

ر – دراسة الحدود الادارية الحالية للمحافظات ومدى صلاحيتها لاجراء عملية التنمية وامكانيات تغيرها .

هـ – دراسة العلاقات التنظيمية الحالية للادارة المحلية وعلاقتها بجهاز التخطيط مع بحث أفضل الأوضاع فى ظل مشاكل المجتمع المصرى الحالية والمتوقعة .

و – وضع أسس تنظيمية للعلاقة بين مستويات التخطيط المختلفة .

●● ولكى تأخذ هذه الدراسات دور ايجابى فى التنفيذ لذا يجب العمل على الآتى :

– توافر الكوادر الفنية المتخصصة فى التنمية الاقليمية سواء على المستوى المركزى او المستوى الاقليمى والمحافظات وتكون تلك الكوادر قادرةعلى اعداد الخطط الاقليمية والحيزية .

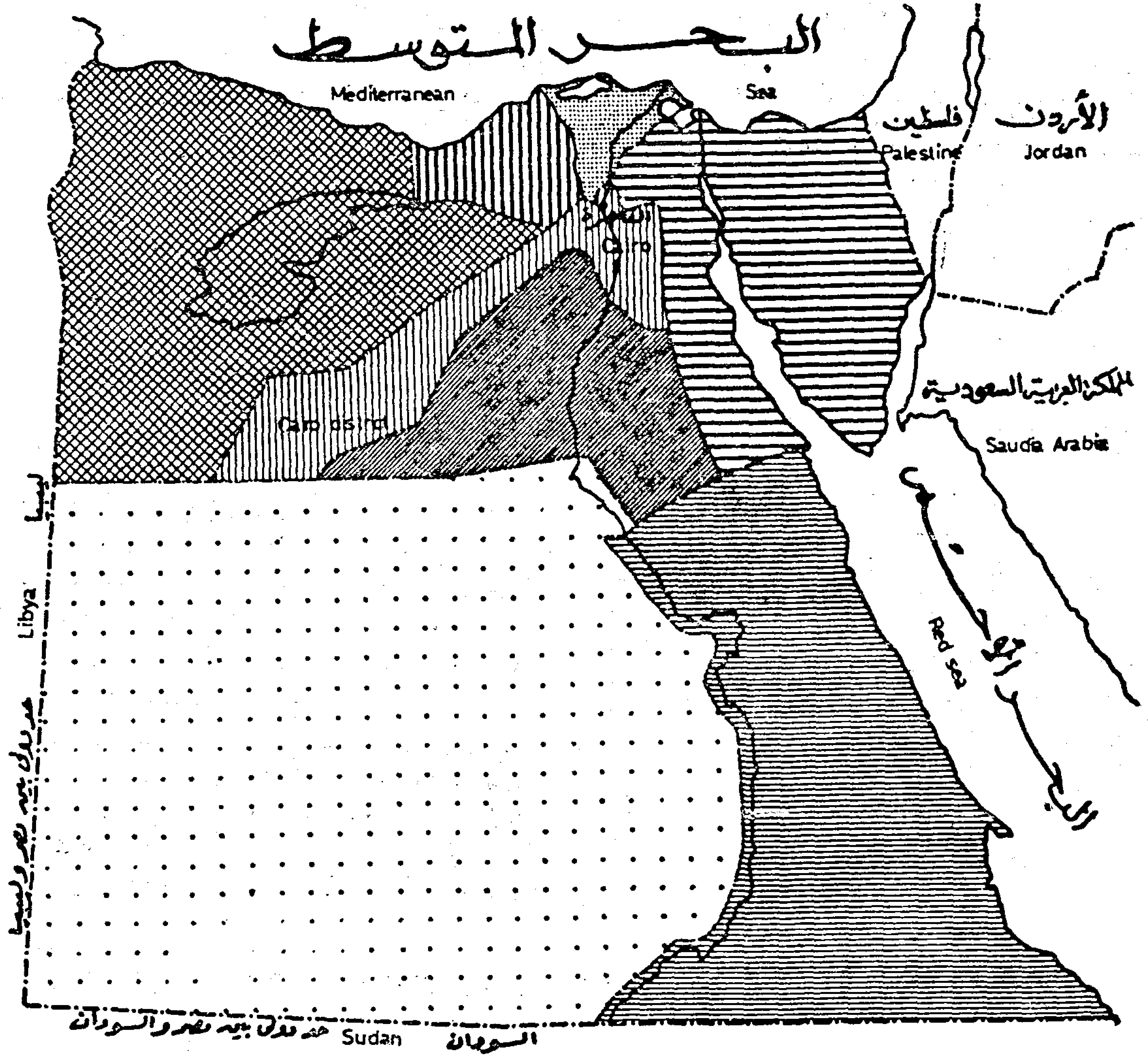
– توافر مراكز البحوث لاجراء الدراسات الفنية والاقتصادية والاجتماعية عن الاقاليم

المختلفة . كما يجب على مراكز البحوث متابعة مراحل تطور الاقاليم لتحديد مراحل نموها واحتياجات كل مرحلة من المراحل .

– توافر البيانات الاحصائية والمعلومات الوظيفية عن الاقاليم المختلفة وكذلك الخرائط التفصيلية بمقاييس رسم مناسبة .

– أعادة النظر فى قوانيين الادارة المحلية والتخطيط القومى والتخطيط الاقليمى مع ضرورة التنسيق بينها لتتكامل مع تحديد دور المحليات والوحدات الاقليمية وهيئات التخطيط العمرانى على المستوى الاقليمى وعلاقة كل منهما مع الأخرى .

– الاهتمام بالهيكل التنظيمية لهيئات التخطيط الاقليمى من ناحية تحديد العلاقة بين تلك وادارات التخطيط المختلفة على مستوى المحافظات .



Cairo	اقليم القاهرة ويشمل محافظات القاهرة والجيزه والقليوبية .	
Alexandria	اقليم الاسكندرية ويشمل محافظات الاسكندرية والبحيرة والمحافظة الجديدة .	
Suez canal	اقليم قناة السويس ويشمل محافظات الشرقية وبورسعيد والاسماعيلية والسويس وسيناء وجزء من محافظة البحر الاحمر .	
Delta	اقليم الدلتا ويشمل محافظات الدقهلية ودمياط وكفر الشيخ والغربية والمنوفية .	
Matrouh	اقليم مطروح ويشمل محافظة مطروح	
North upper Egypt	اقليم شمال الصعيد ويشمل محافظات الفيوم وبنى سويف والمنيا وجزء من محافظة البحر الاحمر	
Assiout	اقليم اسيوط ويشمل محافظات اسيوط والوادى الجديد .	
Southern upper Egypt	اقليم جنوب الصعيد ويشمل محافظات سوهاج وقنا وأسوان وجنوب البحر الاحمر .	

تقسيم جمهورية مصر العربية إلى أقاليم تخطيطية

الصادر بقرار جمهورى لسنة ١٩٧٧

مبـادىء وتوصـيات
فى تصميم وتنفيذ أحواض السباحة الخاصة

د٠م / محمد فتحى البرادعى

انتشرت أحواض السباحة فى مصر فى الفترة الأخيرة بصورة ملحوظة ملحقة بالمسكن الخاص فى المدن الشاطئية او فى الريف أو فى المناطق السياحية نظرا للضغط الشديد داخل المدن بالاضافة للحديث الدائم عن تلوث مياه الشواطىء

واذا كانت أحواض السباحة فى مجتمع مثل مجتمعنا يمكن ان تمثل مؤشر ترف لايتناسب والطبيعة الاقتصادية للمجتمع ، الا أن هذه النظرة لا يمكن ان تجعلنا ننكر ان حوض السباحة الخاص عنصر من العناصر المعمارية التى لا يمكن تجاهلها بصفة عامة أو تجنب دراستها والبحث فيها أو التعرض لها بحساسية خاصة بحيث لا نجد لها مرجعا فى بحث او دراسة مما جعل هذا العنصر موضع تساؤل وجعل البعض يلجأ فى كثير من الاحيان الى أن يعهد به الى أحد وكلاء الأجهزة الخاصة بأحواض السباحة الذى عادة ما يقدم تصميما يتعرض للموضوع من الوجهة التجارية وفقا للوكالة التى يمثلها مفتقدا بذلك الى الابتكار والدراسة المعمارية من حيث التناسق والتكامل مع طبيعة الموقع وطبيعة الاستخدام وارتباطه بباقى العناصر من حيث الوظيفة والشكل مما يؤكد ضرورة وجود خلفية واضحة وكافية عن هذا العنصر لدى المهندس المعمارى تؤهله لتحقيق الهدف من التصميم .

وقد يحضرنى على سبيل المثال أحد المواقف التى لمستها ودفعتنى الى كتابة هذه التوصيات وهو أن عرضت ميزانية مبدئية لحوض سباحة عام على أحد المسئولين فقام باستبعاد أجهزة الترشيح والتعقيم والسحب السطحى ومحولات جهد وحدات الاضاءة واكتفى بطلب انشاء حوض من الطوب بنظام الحوائط الساندة يعزل من الخارج بدهانات بيتومينية ومن الداخل بالقيشانى مع توصيله بمصدر تغذية وطلمبة سحب لصرف المياه حيث أنه قرر الاستفادة بمياه الحوض فى رى حديقة الموقع،وللاسف وجد هذا الطلب المهندس الذى لا يعترض على هذا الفكر الغير متخصص وان كان قد استطاع بعد جهد استبدال الحوائط المبنية بأخرى خرسانية .

وهذا المثال بهذه الصورة يؤكد أن هناك من الحقائق والمعطيات الفنية لكافة العناصر المشاركة فى هذا المنشأ ما يوجب على المهندس ادارك كافة ابعادها وخاصة الادارك الحقيقى لطبيعة المياه والتى تمثل العنصر الأساسى فى هذا الموضوع من حيث أنها محتوى هذا المنشأ والتى أصبحت دراسته علم متشعب الابعاد من حيث التعامل والوقاية من قوته وقدرته على النفاذية ووقايته من التغير والتحلل بحيث لا يتحول وهو المادة الطاهرة النقية الى وسط لانتشار ونقل الامراض .

فبداية يجب أن يكون واضحا ان حوض السباحة بصفة عامة هو منشأ معد ومجهز بحيث يمكن استخدامه لممارسة الرياضات المائية والترفيه وذلك فى ظروف صحية وآمنة وعليه فانه يجب استخدام كافة الطرق الفنية التى تسمح بالرد على احتياجات المستخدم من حيث الراحة مع سهولة الصيانة واقتصادها .

* المياه :

يجب أن يتعرف المهندس أولا على نوعية المياه التى ستستخدم فى ملاء الحوض وذلك لأن نوعية المياه وخاصة اذا كانت مياه جوفية تؤثر فى اختيار نوعية الاجهزة المستخدمة فى التنقية وبالتالى فى حجم غرفة الاجهزة وتوصيلاتها .

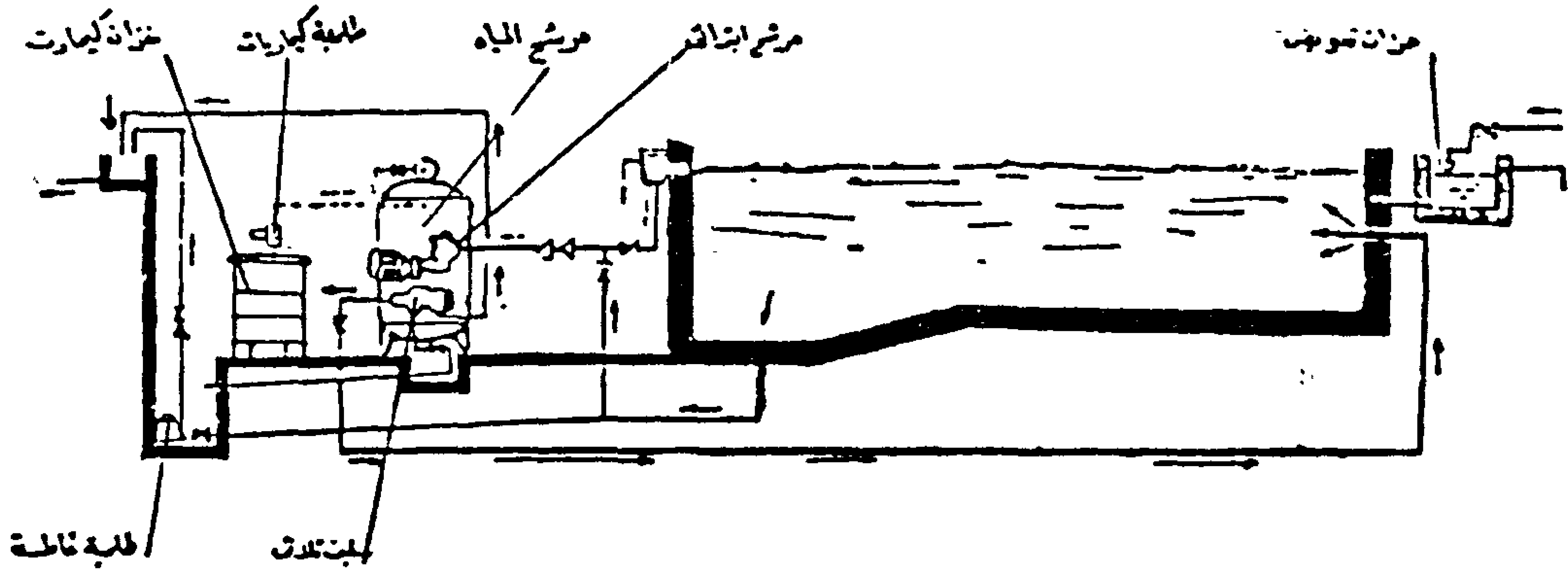
فعلى سبيل المثال قد تحتوى المياه على نسبة عالية من الحديد والمنجنيز وفى هذه الحالة قد نضطر الى استخدام مرشح اضافى لفصل الحديد من المياه . كما ان المياه التى يكون معدل توازنها الهيدروجينى منخفض (أقل من ٧ تكون مرتفعة الحمضية مما يجعل استخدام المواسير والوصلات المعدنية للمياه أمر غير مرغوب فيه .

كما أن المعاملات والمعالجات المطلوبة للمياه فيما بعد يجب أن تكون فى الحسبان قبل إنشاء الحوض حيث ان هناك من المشاكل التى يصادفها مستخدمه فيما بعد قد تؤدى الى استحالة استخدامه ويجدر الاشارة هنا الى احدى المشكلات البسيطة التى تسببت فى اغلاق حوض سباحة عام فور إفتتاحه فى احدى المحافظات بسبب تلون المياه باللون البنى فور البدء فى معالجة المياه بالكلور وهو أمر اعتبره القائمين عليه لغزا يصعب الوصول الى حل له !! الا ان الأمر كان بسيطا ومتوقعا لو أن مصدر المياه الذى يستخدم فى التغذية قد تم تحليله قبل الانشاء وذلك لأن تلون المياه باللون البنى أو الاحمر الداكن يعنى ان نسبة الحديد أو المنجنيز مرتفعه فى المياه وعلى هذا كان يجب معالجة المياه لتقليل نسبة الحديد والمنجنيز ، وهو ما قد يكون ذو تكلفة اقتصادية مرتفعة ، أو تزويد الحوض بشفاط كهربائى (مكنسة كهربائية تحت الماء) من النوع المستقل الذى يمكنه جمع براده الحديد التى تتجمع فى القاع والتخلص منها حتى لا يتحمل المرشح عبئها وحده مما قد يعوق عمله بكفاءة .

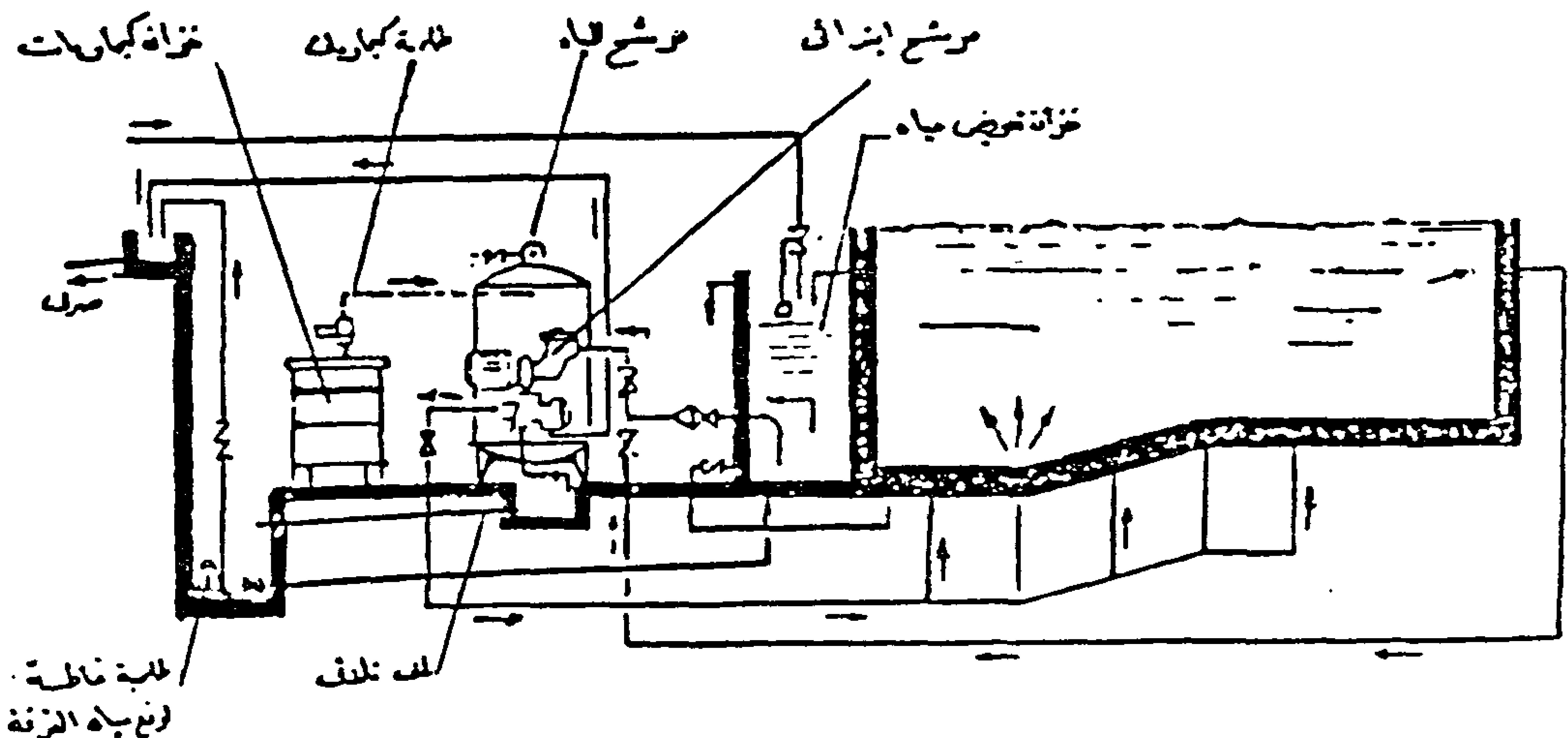
ووجود هذه المعادن بنسب كبيرة فى المياه قد يؤدى الى وجود بقع صفراء أو بنيه على الجدران والقاع وتوقع ظهور هذه البقع قبل البدء فى التصميم يؤدى بدوره الى البعد عن استخدام الدهانات فى التشطيب الداخلى واللجوء إلى تكسيه داخلية بديله يمكن تنظيفها بالسنفره دون حدوث بؤر أو خدوش بها مثل السيراميك

كما ان هذه المعادن قو تؤدى أيضا الى تآكل المواسير والوصلات المعدنية والذى قد يحدث أيضا نتيجة للتحلل بالكهرباء الناتج من اتصال معدنين من معادن المياه بالكيماويات المضافة .

وعلى كل فانه يمكن القول بصفة عامة أن المياه الجوفية الموجودة بوسط الدلتا قلوية أى ان توازنها الهيدروجينى يحتاج الى اضافة أحماض اما المناطق القريبة من السواحل فغالبا ما تكون حمضية وتحتاج الى اضافة كربونات الصوديوم حيث انه من المعروف أن قلوية المياه تؤدى الى عدم فاعلية المطهرات فى المياه . أما فى حالة حمضية المياه فانه يلاحظ تآكل المعادن وتغير لون الدهانات الداخلية للحوض كما ان المياه فى هذه الحالة تسبب إلتهاب الجلد وأحمرار العين لمستخدم الحوض .



قطاع توضيحى فى حوض سباحة يمثل الوضع الشائع فى التغذية والسحب



قطاع توضيحى فى حوض سباحة يتم تغذيته من أسفل والسحب من أعلى

شكل (١)

ومن هذا يتضح لنا انه من الاهمية أن يكون امام المهندس تحليلا للمياه التى ستغذى حوض السباحة قبل البدء فى التصميم حتى يتمكن من اتخاذ القرار السليم من حيث نوعية الحوض وتشطيبه واختيار الأجهزة ونوعية التوصيلات.

اجهزة ومعدات حوض السباحة الخاص :

على المهندس أن يحدد الاجهزة الملائمة للتصميم وذلك وفقا لحجم المياه ونوعيتها والظروف الخارجية المؤثرة على نقائها وذلك فى حدود ان يضمن دورة كاملة لمياه الحوض من خلال المرشح فى فترة زمنية لا تزيد عن ٦ ساعات وذلك بحساب مكعب المياه واختيار مرشح ذو طاقة قادرة على استيعاب كامل المكعب خلال الفترة الزمنية المحددة .

وفى امكاننا تبسيط هذه المعدات كما يلى :ـ

١ ـ المرشح .

٢ ـ منافذ السحب السطحى .

٣ ـ مداخل التغذية بالمياه .

٤ ـ أجهزة التسخين (وهى غير ذات أهمية فى جو مصر) .

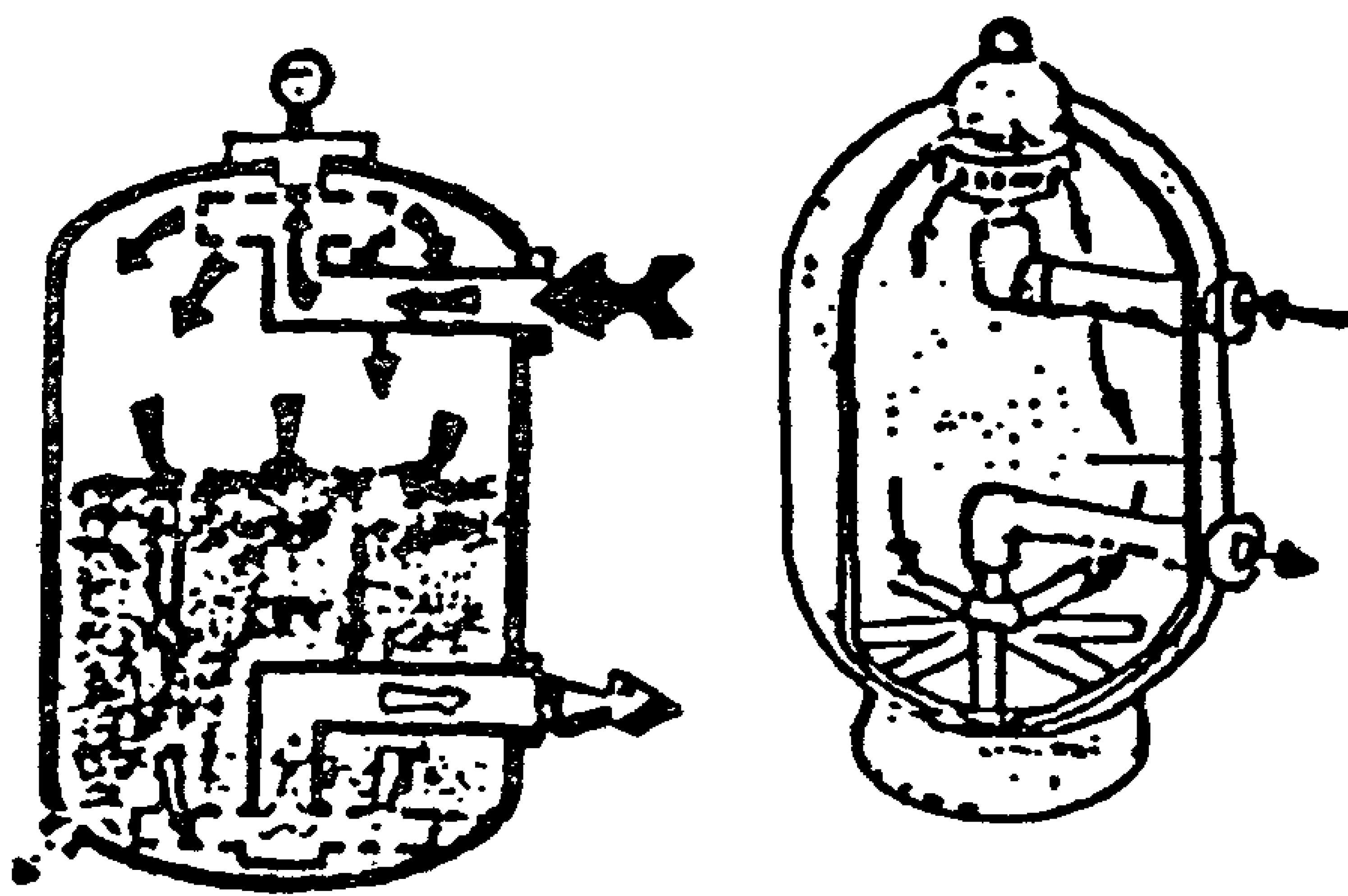
١ ـ مرشح المياه :

وهو العنصر الذى لا غنى عنه بالنسبة لأحواض السباحة فمن المعروف أنه باستخدام مرشح جيد مع معالجة منتظمة للمياه فان المياه يمكن الاحتفاظ بها فى حوض السباحة لعدة أعوام مع تعويض كمية المياه التى قد تنقص نتيجة البخر او غسيل المرشح أو تناثر المياه أثناء الاستخدام والمرشح عادة يكون مزودا بطلمبه مياه وموتور ومرشح ابتدائى صغير وتوصيلات المياه الخاصة به وبلف ثلاثى لامكانية عكس دورة المياه لغسيل المرشح نفسه .

ويوجد بصفة عامة ثلاثة انواع من المرشحات

(أ) المرشح الرملى :

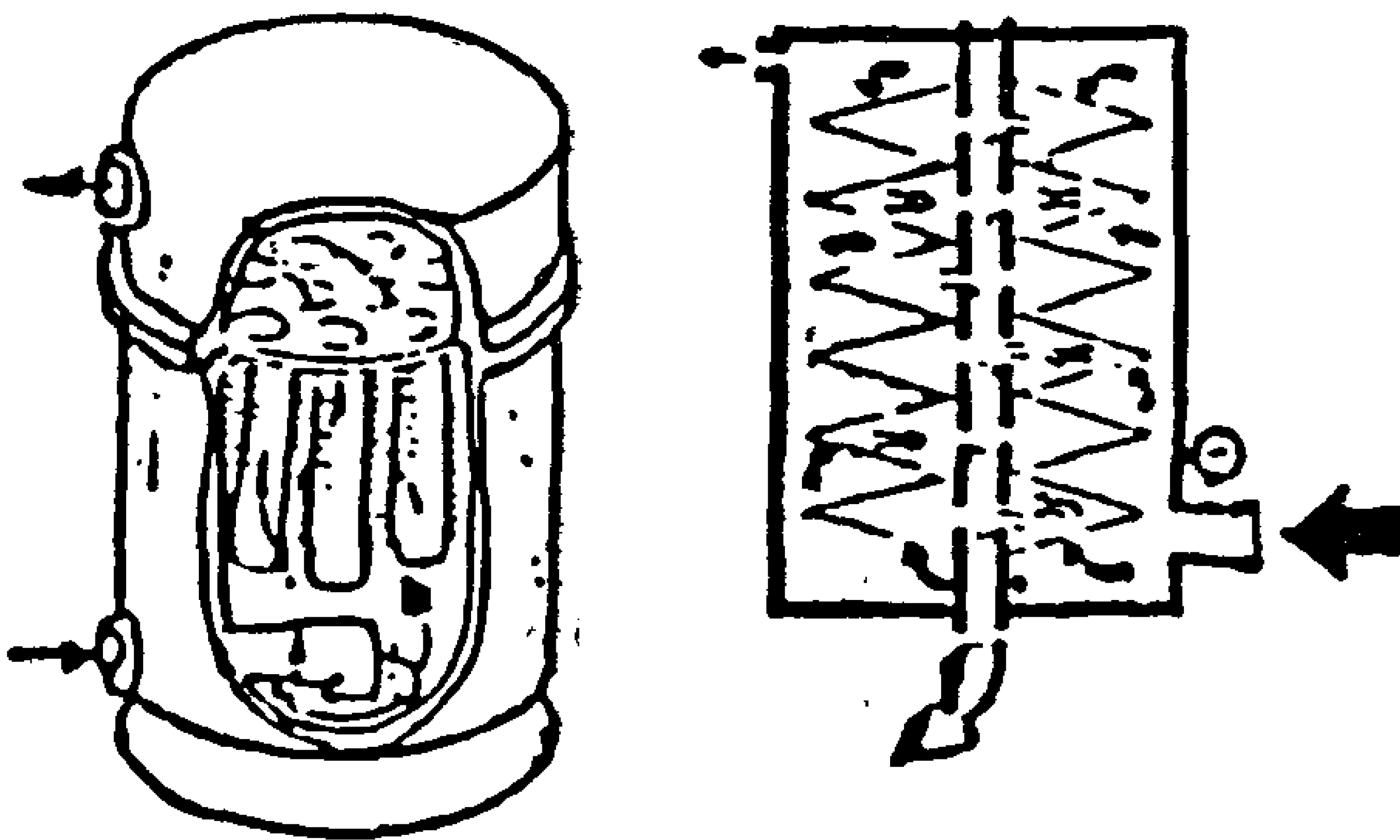
وهو اكثر الأنواع شيوعا وهو عبارة عن وعاء يتحمل الضغط من الحديد المعالج أو الفيبرجلاس ويسمح نظام التغذية والصرف بمرور المياه من خلال عدة طبقات خاصة بداخله من الحبيبات الرملية بأقطار متدرجة لفصل الشوائب من المياه . ويمكن الاحتفاظ بهذه الحبيبات لعدة سنوات دون الحاجة لتغييرها . كما يتم تنظيف المرشح بمجرد عكس الدورة والتخلص من المياه الناتجة من غسيل المرشح .



(أ) مرشح رملى

(ب) المرشح الدياتومايتى :

ويتميز بصغر حجمه وقلة المياه المستخدمة فى الدورة العكسية كما يتميز بقدرته على نصل الشوائب الدقيقة من المياه وتقوم بعملية الترشيح بودرة طباشيرية بيضاء ناتجة عن سحق الهيكل الميكروسكوبى المتحجر لحيوان بحرى صغير يسمى الدياتوميت ويتم تغيير هذه البودرة كلما ارتفع مؤشر قياس ضغط المرشح مما يدل على انسداد كافة المسام .

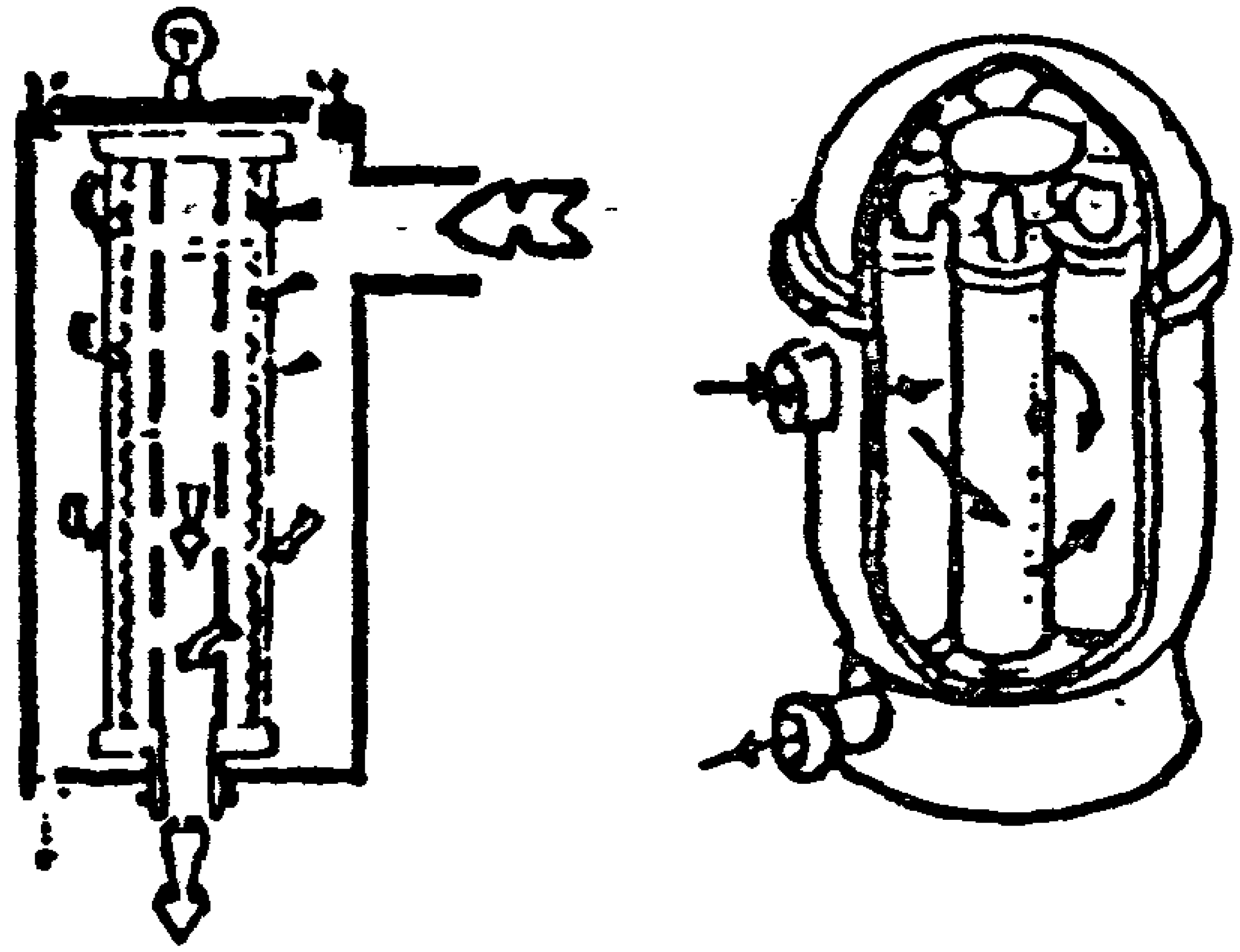


(ب) مرشح دياتومايتى

(جـ) المرشح ذو الخراطيش :

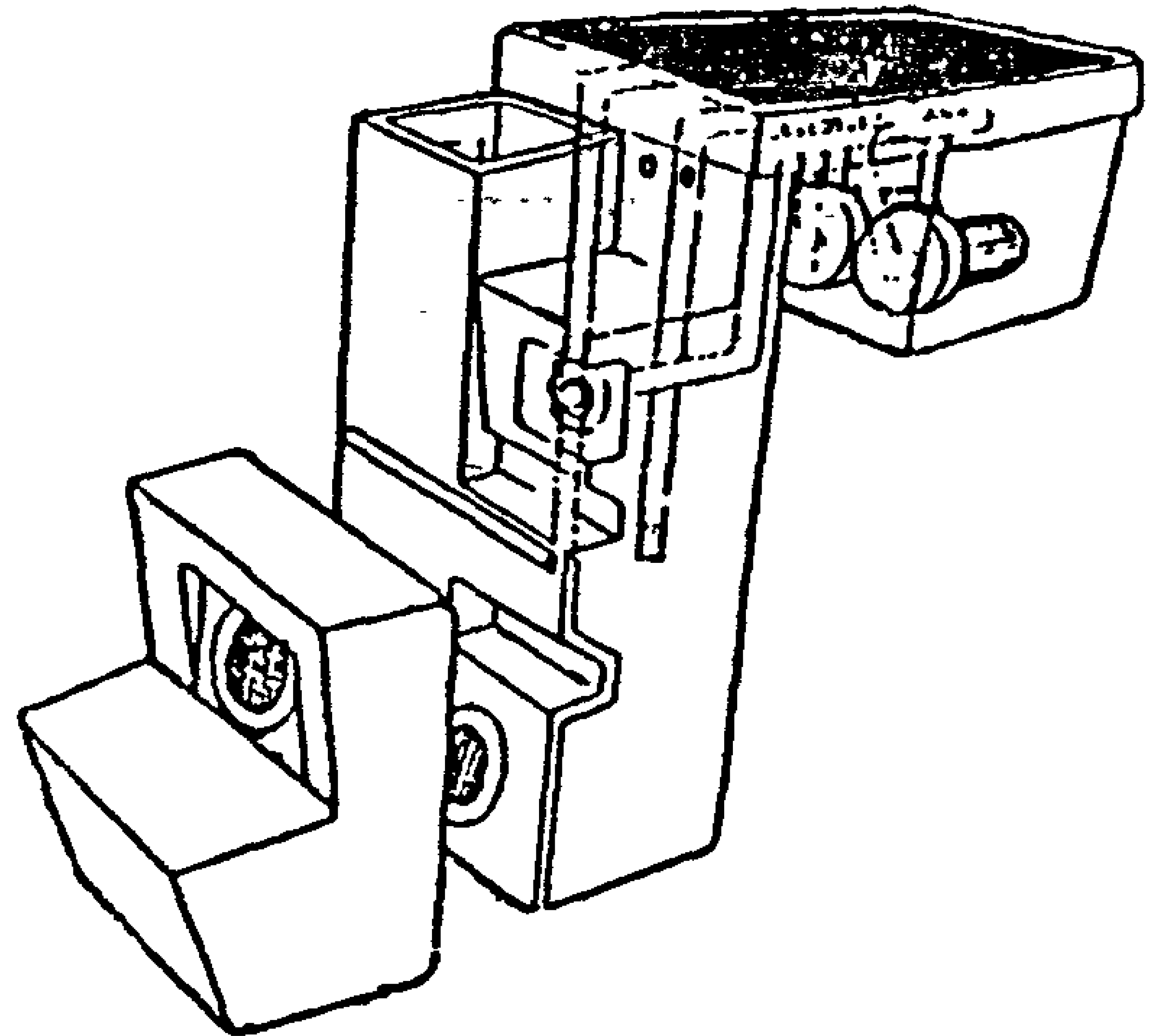
ويستخدم فيه خراطيش الألياف الصناعية وتكون مضلعة لتوفير أكبر مسطح ترشيح فى أقل حيز ممكن . ورغم ان هذه الخراطيش يجب استبدالها على فترات حسب نسب تلوث المياه الا ان تكلفتها غير مرتفعة كما يمكن تنظيفها بتيار مائى قوى . كما انه يلاحظ ان هذه الخراطيش يجب استبدالها عند بداية تشغيل حوض سباحة خرسانى تم تشطيبه بالبياض نظرا لانسداده برواسب البياض . ومن عيوب هذا النوع من

المرشحات أنه غير قادر على فصل الشوائب الدقيقة .



(جـ) مرشح ذو خراطيش

كما أنه يجدر الاشارة الى أن هناك وحدات مجمعة كاملة لأحواض السباحة صغيرة الحجم يتم تثبيتها على جدار الحوض وتحتوى على المرشح ومدخل التغذية بالمياه وفتحة السحب السطحى ووحدات الاضاءة وبها جهاز لضخ المياه تحت ضغط لعمل تيار مقاوم يسمح بالسباحة فى مسافة قصيرة دون توقف وكذلك مخرج لمياه تحت ضغط لعمل تدليك بالجسم وتستخدم الوحدة أيضا كسلم للجمام .



نموذج لوحدة مجمعة لأحواض السباحة صغيرة الحجم

وبصفة عامة نستطيع ان نشير هنا الى توصية هامة خاصة بمنسوب طلمبه المرشح التى يجب أن تكون فى منسوب أقل من منسوب سطح مياه الحوض بحوالى ٢٥ سم على الاقل وذلك لضمان تغطيتها دائما بالمياه لعدم تلفها .

أما بالنسبة للرأى القائل بامكانية وضع الطلمبة اعلى من منسوب سطح المياه مع استخدام بلف عدم الرجوع فانه بنبغى الحذر الشديد عند الاخذ به نظرا لأن المياه غالبا ما يكون بها بعض الشوائب الصغيرة التى قد تتسبب فى عدم تشغيل بلف عدم الرجوع بالكفاءة المطلوبة بحيث يؤدى دائما الى تسريب المياه وتعريض الطلمبة للتلف .

٢ ــ منافذ السحب السطحى :

وهى عبارة عن فتحات عند منسوب سطح المياه متصلة بخط السحب المؤدى الى المرشح بحيث تكون وظيفتها سحب الطبقة السطحية للمياه بصفة مستمرة نظرا لان هذه الطبقة هى التى تعلق بها الأتربة والحشرات الطائرة الصغيرة ولذا يجب سحبها بصفة مستمرة .

وهنا تأتى ملاحظة هامة بالنسبة لوضع هذه الفتحات التى يجب أن تكون دائما فى الضلع المواجه لاتجاه الرياح السائدة حتى تعمل الرياح على تجميع الأتربة والعوالق السطحية فى اتجاه فتحات السحب مما يساعد على سرعة سحبها والتخلص منها .

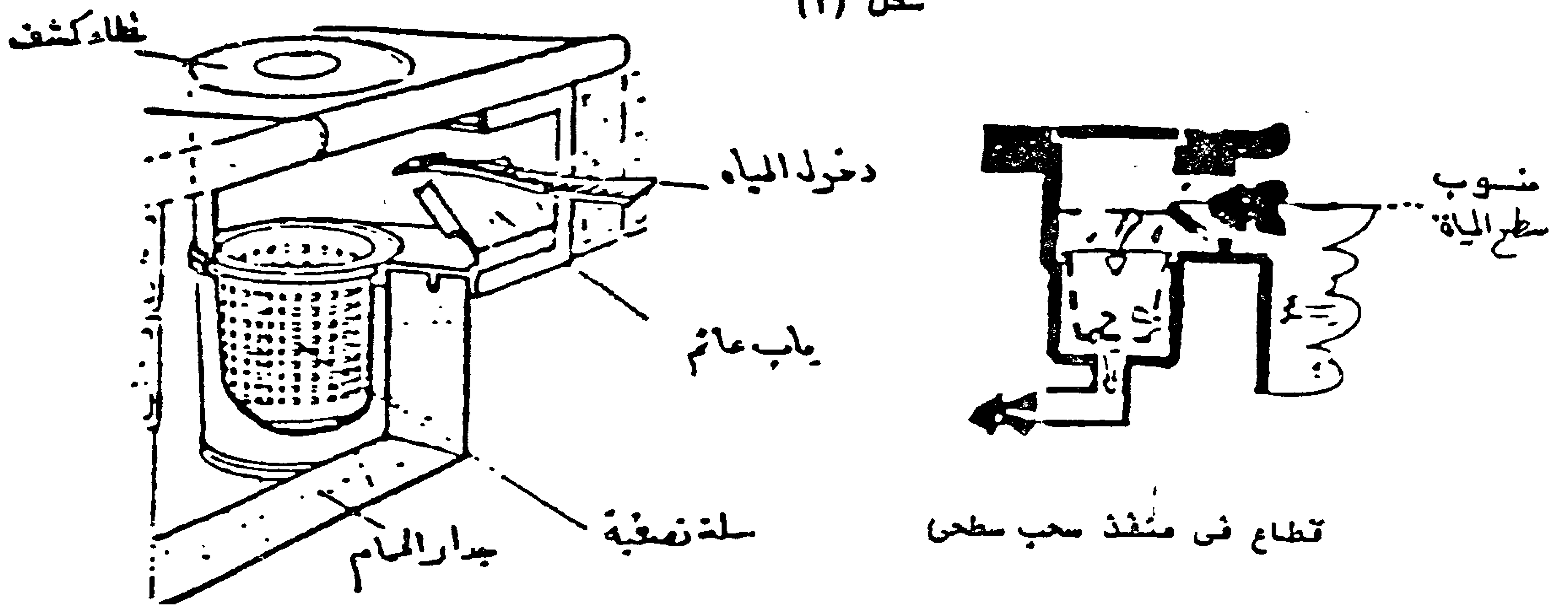
٣ ــ منافذ التغـذية :

وهى فتحات التغذية بالماء والتى غالبا ماتكون ذات مخرج متحرك لامكانية توجيه المياه بما يحقق دورة سليمة للمياه دون وجود مناطق راكدة فى مياه الحوض . ونتيجة طبيعية للملاحظة السابقة الخاصة بمنافذ السحب السطحى فان الوضع الطبيعى لمنافذ التغذية يأتى فى الضلع المواجه لفتحات السحب السطحى وأحيانا تتم التغذية بالمياه من فتحة فى قاع الحمام على أن يكتفى بالسحب من فتحات السحب السطحى الا أن هذا الوضع يقلل من ضمان عدم وجود أماكن راكدة .

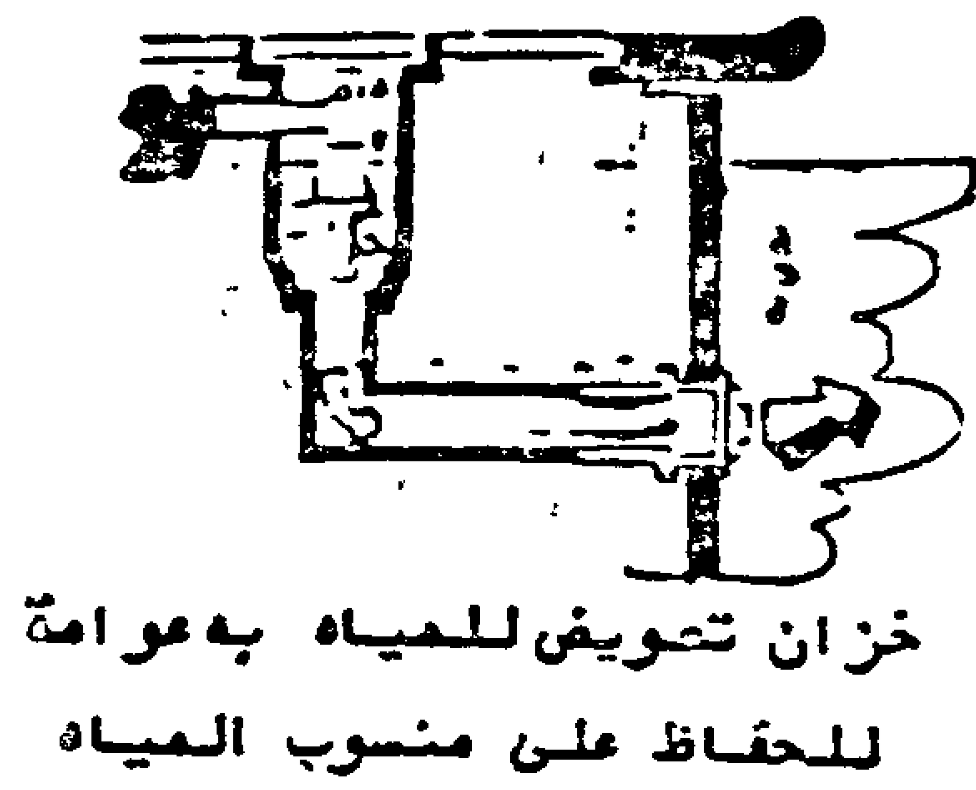
*** تصميم حوض السباحة :**

والعامل الثانى الهام الذى يؤثر على تصميم الحوض هو المحيط الذى يوجد به الحوض من حيث المساحة المحيطة والمبنى او المبانى السكنية المتصلة به ونرعية الكنتور الموجود بالموقع والأسجار والمزروعات .

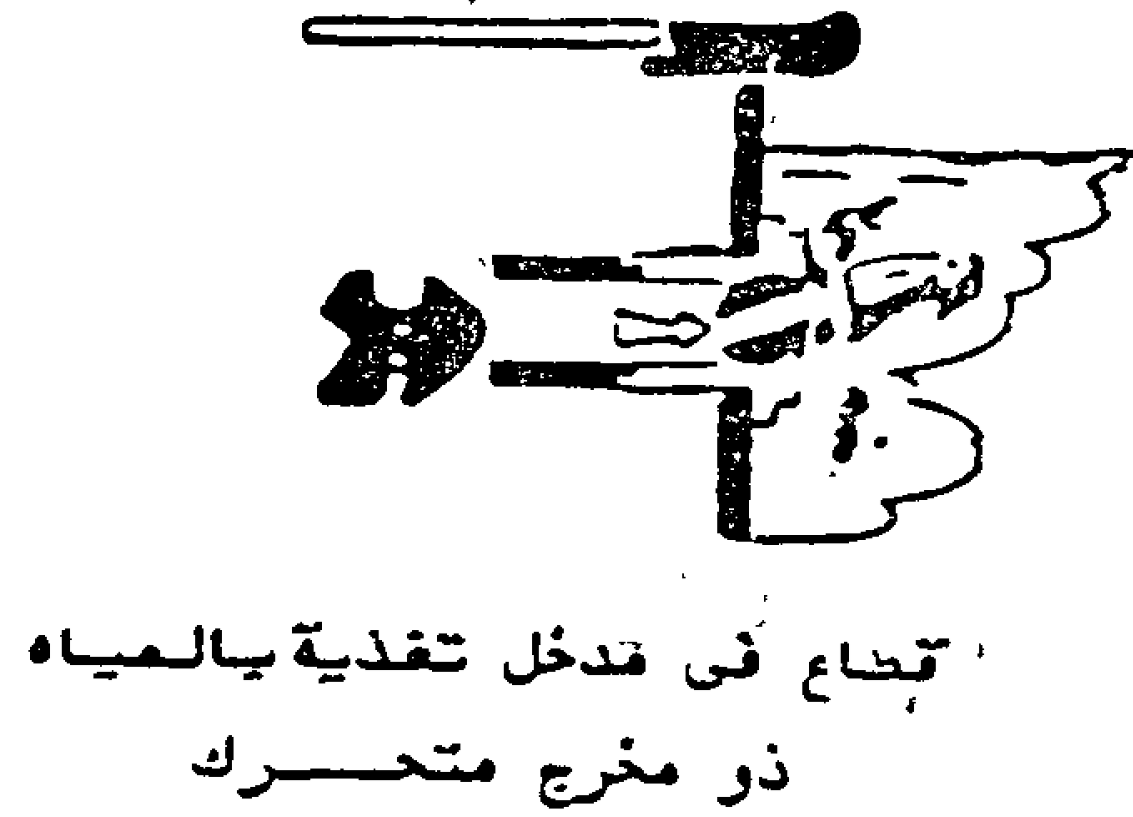
شكل (٢)



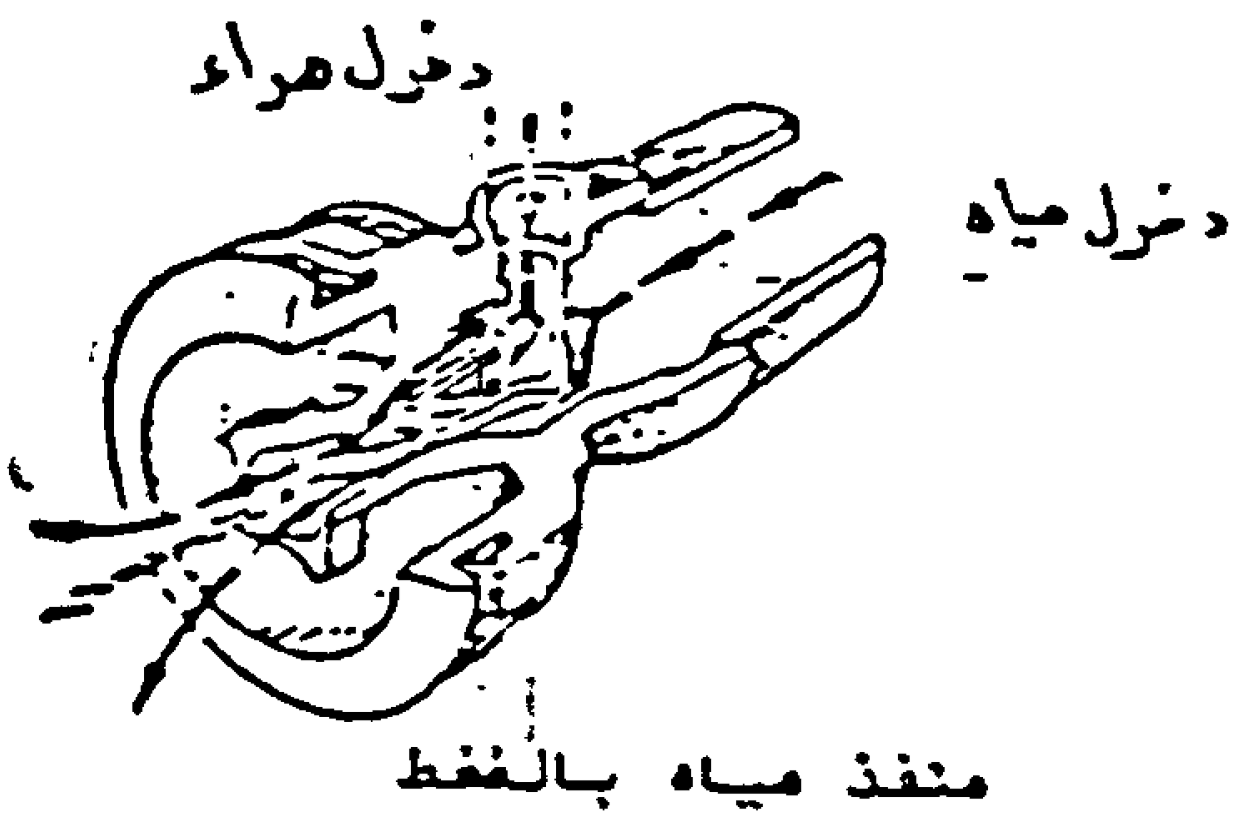
قطاع فى منفذ سحب سطحى



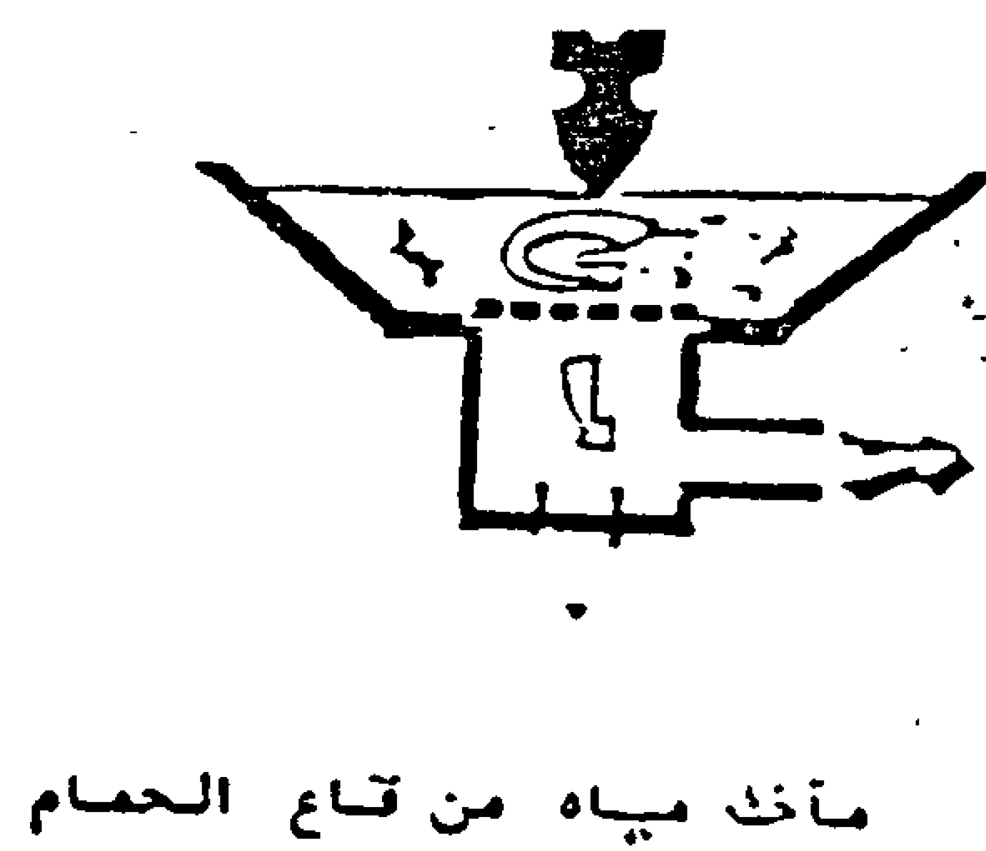
خزان تعويض للمياه بعوامة للحفاظ على منسوب المياه



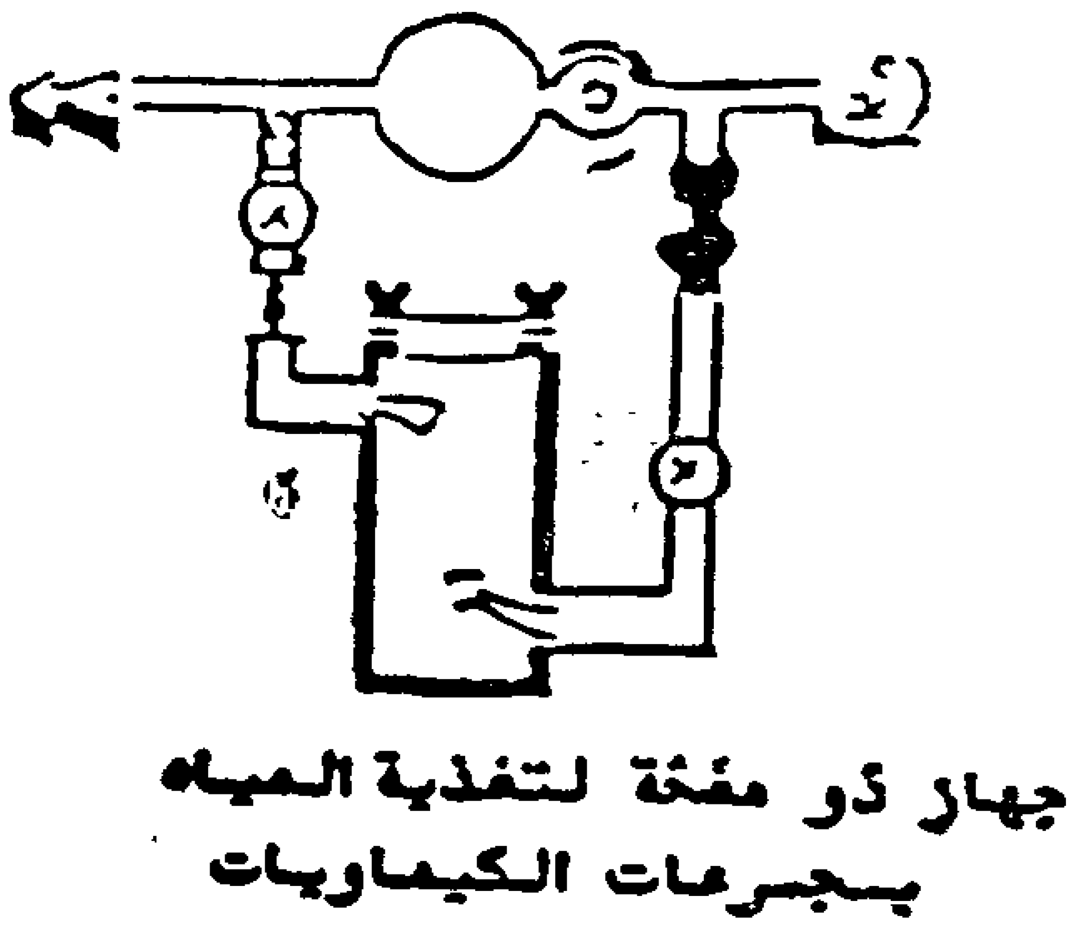
قطاع فى مدخل تغذية بالمياه ذو مخرج متحـــــرك



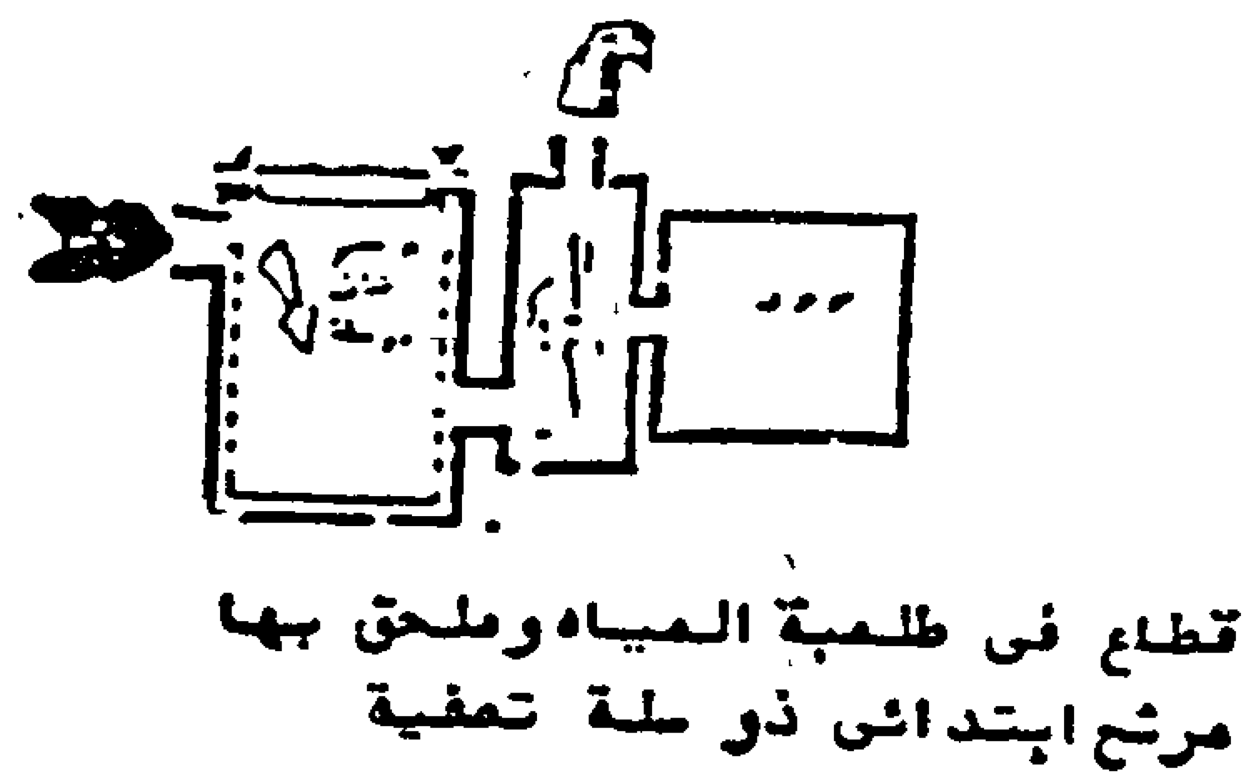
منفذ مياه بالضغط



مأخذ مياه من قاع الحمام



جهاز ذو مضخة لتغذية المياه بجرعات الكيماويات



قطاع فى طلمبة المياه وملحق بها مرشح ابتدائى ذو سلة تصفية

أنواع أحواض السباحة

تحت سطح الأرض

أحواض تقليدية

النهو الداخلي :

خرسانة — • شدات عادية • شدات خاصة • بالحلن — دهانات خاصة • بياض معالج • مواد راتنجية • بوليستر • بلاطات سيراميك •

مباني — بوليستر

أحواض مصنعة

النهو الداخلي :

رقائق معدنية — P.V.C.

خشب — P.V.C. / خشب

بوليستر — قطعة واحدة / أجزاء للتجميع

بانوهات — • معدنية • بلاستيكية — P.V.C.

طرق تصنيع خاصة P.V.C. — P.V.C

فوق سطح الأرض

رقائق معدنية

مطاط

طرق تصنيع خاصة

وهناك حالتان لانشاء حوض السباحة الخاص:

- ان يكون المسكن قائما ومطلوب اقامة حوض سباحه فى المحيط الخارجى ملحقا بالمسكن .

- ان يكون التصميم يشمل من البدايه حوض سباحة ملحق بالمسكن .

وفى الحالة الاولى يجب ان ندرس كيفية ملاءمة تصميم الحوض مع المسكن من حيث الشكل والاستخدام ومن حيث المساحة المطلوب اقامة الحوض بها فقد تكون المساحة محدودة وغير منتظمة الشكل مما يضطر المهندس الى تخليق وتوفيق شكل معمارى منتظم من واقع محددات الموقع ومتطلبات الاستخدام (شكل ٤) .

وهنا قد يكون استخدام الخرسانة فى بناء الحوض هو الحل الأمثل ان لم يكن الوحيد لما تعطيه الخرسانة من امكانيات واسعة فى التشكيل تتطلبها مرونة الشكل .

وكذلك فان هذه الحالة تجعلنا ندرس امكانية وضع الأجهزة فى جراج قريب أو فى بدروم المسكن .

وفى حالة اتساع رقعة الأرض المحيطة بالمسكن القائم بحيث يمكن الابتعاد عن المسكن فان الحوض سيكون عنصرا متكاملا بملحقاته من دورة مياه وغرفة ملابس وأوفيس صغير وغرفة الأجهزة وهى فى مجموعها يجب أيضا ان تستوحى شكلها العام من المسكن القائم .

أى اننا نستطيع القول بعبارة أخرى انه فى هذه الحالة يكون لدينا تكوين بصرى وخلفية جمالية متوازنة وقائمة بين المنزل وحديقته والتالى يجب على العنصر الجديد أن يتكامل مع هذا التكوين دون ان يبدو دخيلا عليه خاصة وانه سيكون مرآه لهذا التكوين (شكل ٤) .

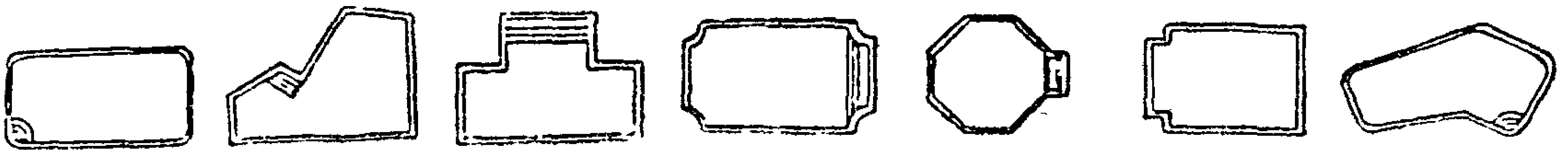
أما فى الحالة الثانية والتى تكون امكانيات الدراسة فيها متعددة فان حوض السباحة يمكنه أن يتداخل مع المبنى كليا أو جزئيا او ينفصل عنه جزئيا او كليا فى اطار التكوين الموحد .

وبعبارة أخرى فاننا فى هذه الحالة نستطيع ان نختار بين الاتجاهات بحرية وانطلاق ، من حيث قرب أو بعد الحوض عن المسكن فمن المعروف انه يوجد اتجاه بأبعاد الحوض عن المسكن - ان أمكن - نظرا لاعتباره مكان صاخب الى حد ما مما قد يؤدى الى ازعاج المسكن . والاتجاه الآخر يرى ان زرقة المياه وما تضفيه من لمسة جمالية الى طبيعة المكان يجب الا يحرم منها المسكن : كما أن قربه من المسكن يعطى امكانية أفضل للرقابة المطلوبة على الأبناء نظرا لان الحوض باعتباره نقطة عميقة وقريبة من المسكن يشكل خطورة على الأطفال وان كانت هناك أجهزة فى الأسواق للانذار فى حالة سقوط أى جسم بالحوض .

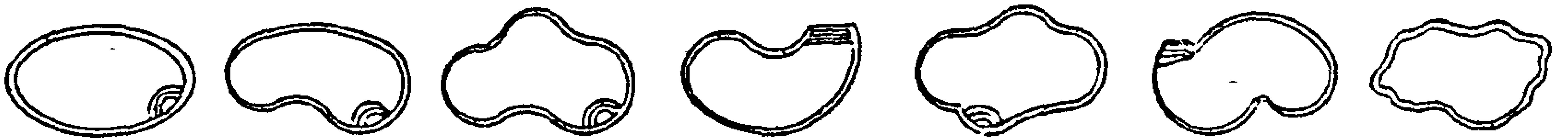
وكذلك فاننا فى هذه الحالة قد نستطيع تصميم اشكال محددة مما قد يعطينا امكانية استخدام مواد أخرى غير الخرسانة فى جسم الحوض من الأنواع السابقة التجهيز أو التى يتم تجهيزها بالموقع وفق اشكال متنوعة لكن محدودة .

بعض النماذج شائعة الاستخدام فى أحواض السباحة الخاصة

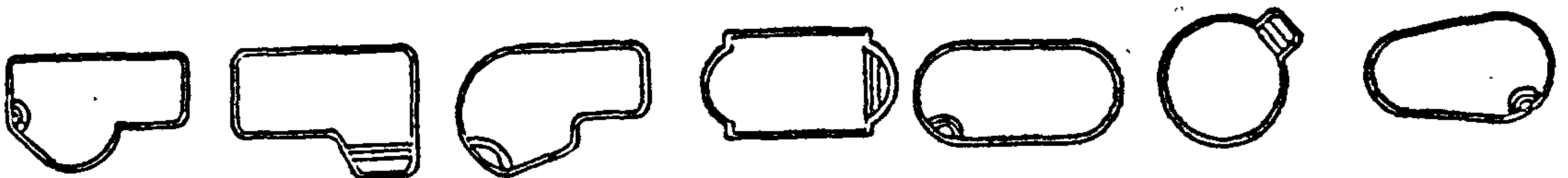
*** خطوط منتظمة**



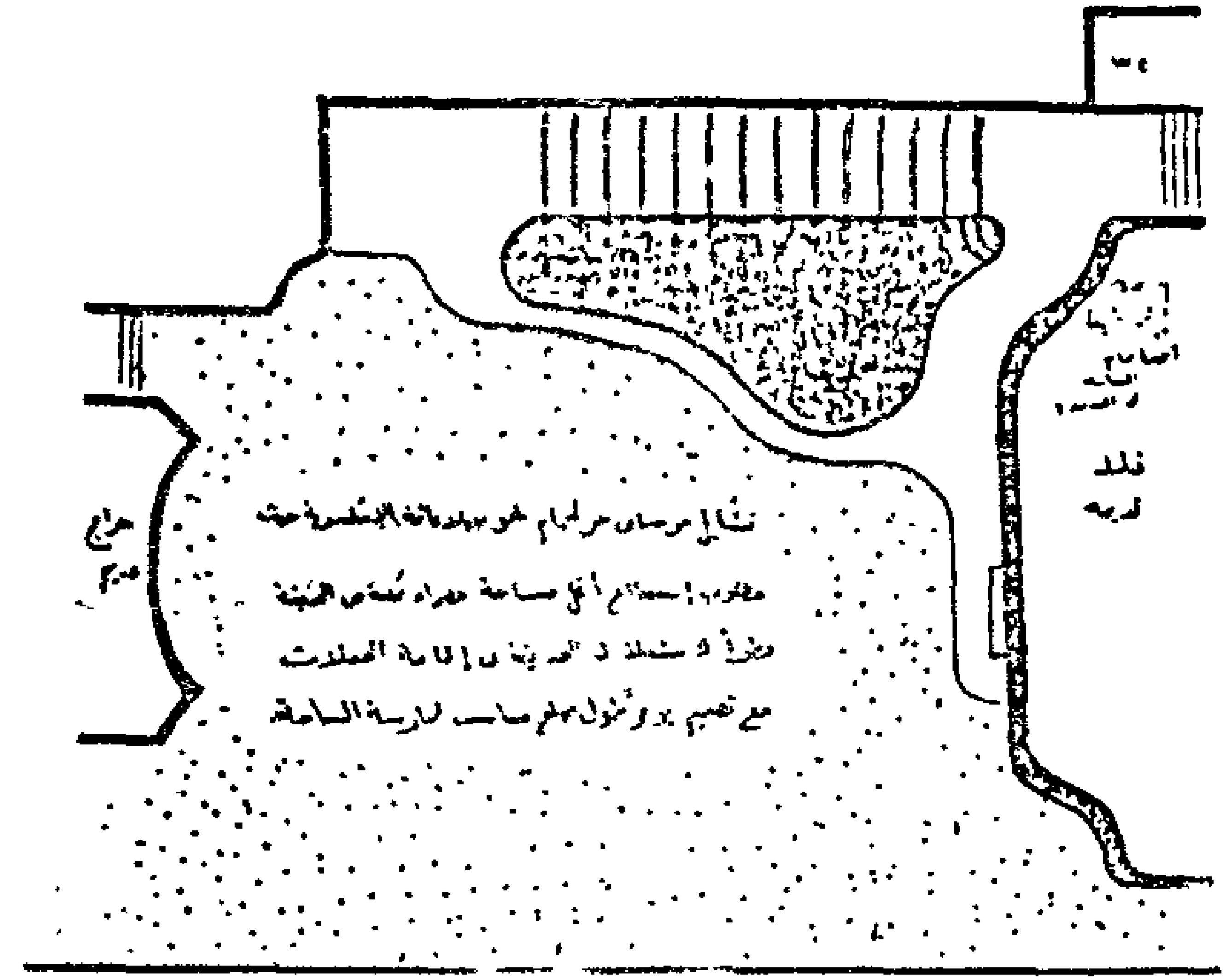
*** منحنيات**



*** تداخل الخطوط والمنحنيات**

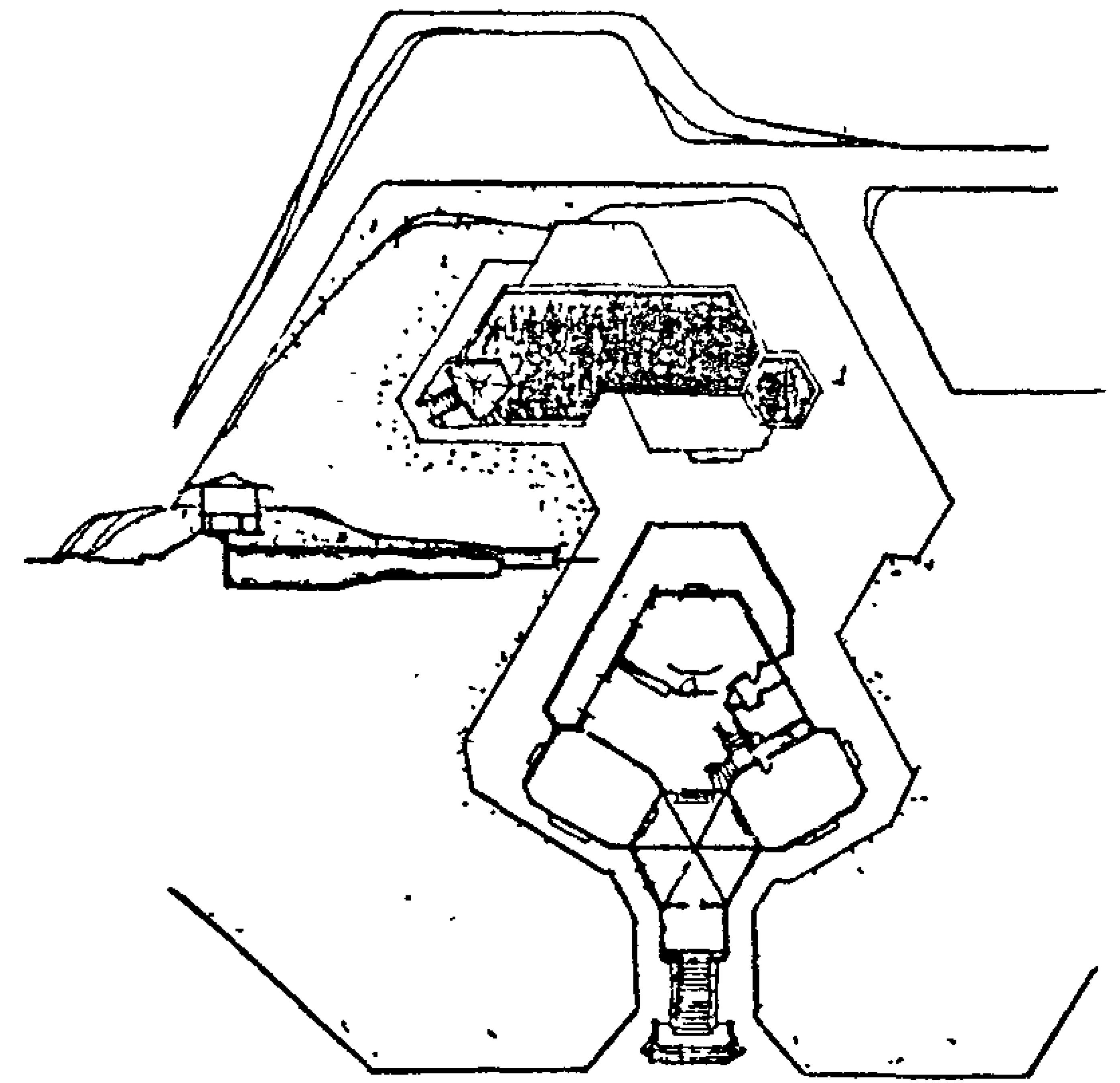


(شكل ٣)



شـكل رقم ٤

تشكيل خرسانى حر لحوض سـباحة ملحق بفيلا قائمة بالاسكندرية حيث مطلوب استقطاع أقل مساحة خضراء ممكنـة من الحديقـة نظرا لاستغلال الحديقة فى اقامة الحفلات مع تصميم يوفر طول ضلع مناسب لممارسة السـباحة .



تصميم لحوض سباحة يتكامل مع تشـكيل المبنى السكنى وروعى فيـه ارتفاع الجوانب للوقاية من السقوط واستخدام ناتج الحفر فى عمل هضاب صناعية . فيلا سكنية بوسـط الدلتـا .

(شـكل ٥)

وفى كلتا الحالتين يجب مراعاة النسـبة بين الحديقة ومساحة الحوض بحيث لا يطغى الحوض على الفراغ الكامل فى حالة الحديقة الصغيرة أو ان يظهر صغيرا جدا فى حالة الحدائق الواسعة .

ويجب مراعاة موقـع الحوض من الشمس ودراسة حركة ظلال الأشجار والمبانى المحيطة به بحيث يمكن الاسـتفادة منها فى تدفئة الميـاه وكسر حـدة البرودة بها مع ضرورة ان يكـون الحوض فى معزل عن تيارات الهواء أو قد تقوم ستارة من الاشجار أو بعض الحوائط الصغيرة التى تدخل فى دراسة المحيط بهذه المهمة ..

علما بأنه عند اختيار الاشـجار القريبة من الحوض يراعى ان تكون من الانواع التى لاتسقط أوراقا كثيرة مثل النخيل او الموز او ان تبعـد الأشجار البعد الكافى لعدم سقوط الأوراق فى المياه . وكذلك يراعى الابتعاد عن انواع الاشجار التى تجتذب الحشرات أو التى تحتاج للمعالجة المستمرة بالرش بالمبيدات الحشرية وخاصة فى الصـيف .

كما أننا يجب الا ننسى انه بالنسبة لدراسـة تنسيق الموقع يمكننا الاسـتفادة من معكبات الردم الناتج من حفر الحوض فى تعلية وتمهيد الممرات واقامة بعض الهضـاب الصناعية التى تساعد على خلق تشكيل حيوى جديد لمحيط الحوض .

وقد نستطيع هنا أن نتطرق الى ملحوظة هامة من حيث قطاع حوض السباحة الخاص حيث يجب مراعاة الجانب الاقتصادى من حيث عمق المياه نظرا لعدم وجود أهمية للعمق الشـديد فى الاستخدامات العائلية لامكانيـة ممارسـة الانسان للسباحة جيدا فى مياه بعمق من ٨٠ الى ١٠٠ سم . لذا فان الاهم فى الحوض العائلى هو مسطح المياه اكثر من العمق الشديد والذى يترتب عليـه مكعب أكبر للمياه يرفع تكاليف المرشح والصيانة ومعالجات الميـاه دون داع ، وعلى ذلك يمكن القول أن العمق الذى يتراوح بين ١١٠ و١٤٠ سم يعتبر عمقـا مناسـبا واقتصاديا بالنسبة للاحواض العائلية مع مراعاة الا يقل اقل عرض فى الحمام عن ٤ متر لامكانية سباحة شخصين والاكتفاء بمسطح يتراوح بين ٤ متر × ٨ متر ، ٤ متر × ١٠ متـر للاسرة المتوسطة وبعض الاصدقاء .

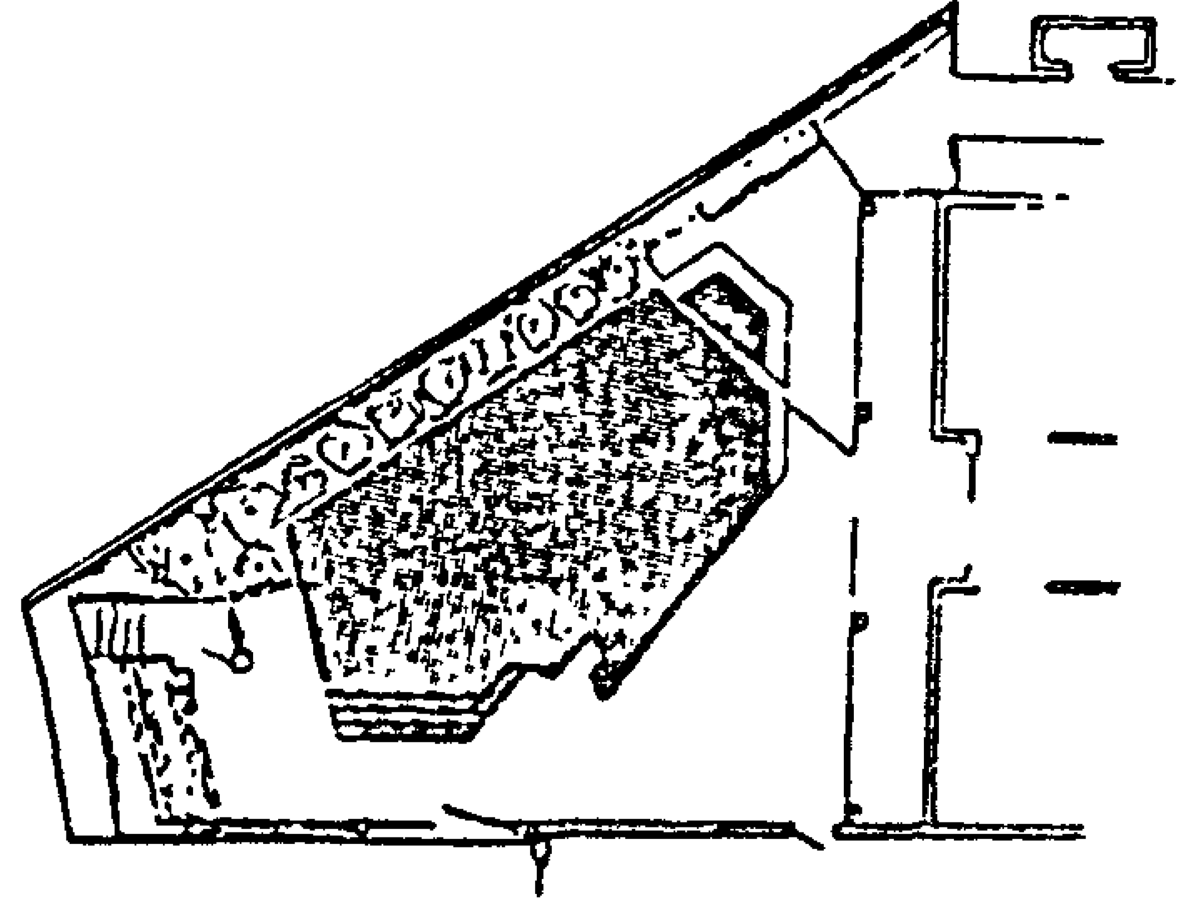
كما أنه خوفا من سقوط الأطفال فى حوض السباحة فى حالة وجود موقعه مواجها لمكان لهو الأطفال أو ركضهم بسرعة أو ركوبهم الدراجات فانه من الممكن الارتفاع بجوانب الحوض (منسوب سطح مياه الحوض) عن منسوب سطح الأرض المحيطـــــة به من ٤٠ الى ٧٠ سم . بحيث تشكل واقيا من السقوط فى المياه ويساعد هذا الارتفاع بدوره على عـــدم اقتراب الحشرات والزواحف الصغيرة من المياه مـــع الوضـــع فى الاعتبار امكانية عمل مناطق مرتفعة حـــول الحوض للتغلب على الحاجز البصرى الذى قـد يشكله ارتفـــاع الجـــوانب وذلك باستخدام ناتج الحفر .

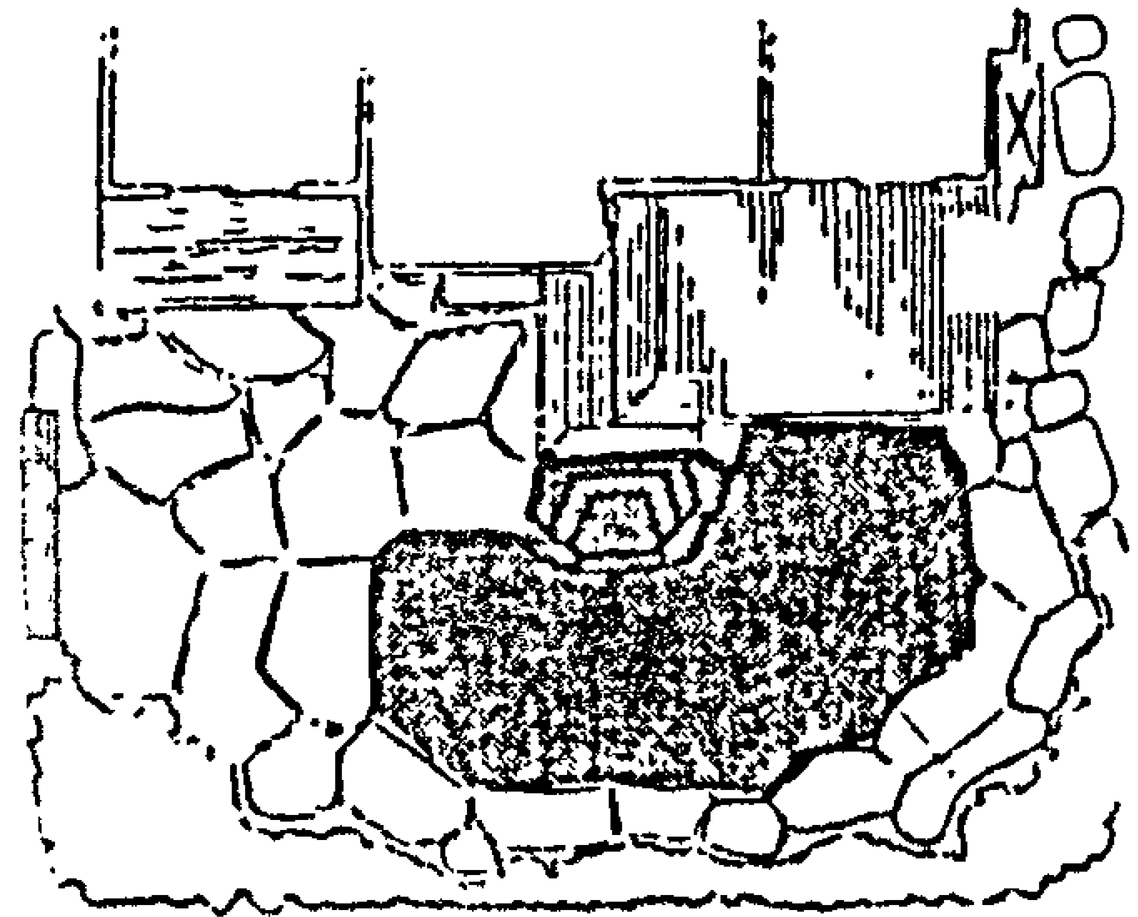
وبالنسبة لوحدات الاضاءة وأجهزة التحكم فيها وتوصيلاتها فيجب أن يكون معلوما أن هناك « حيز وقاية كهربائية » للحوض بحيث تكـون كافة الوصلات والأجهزة الكهربائية بداخله ذات جهد منخفض .

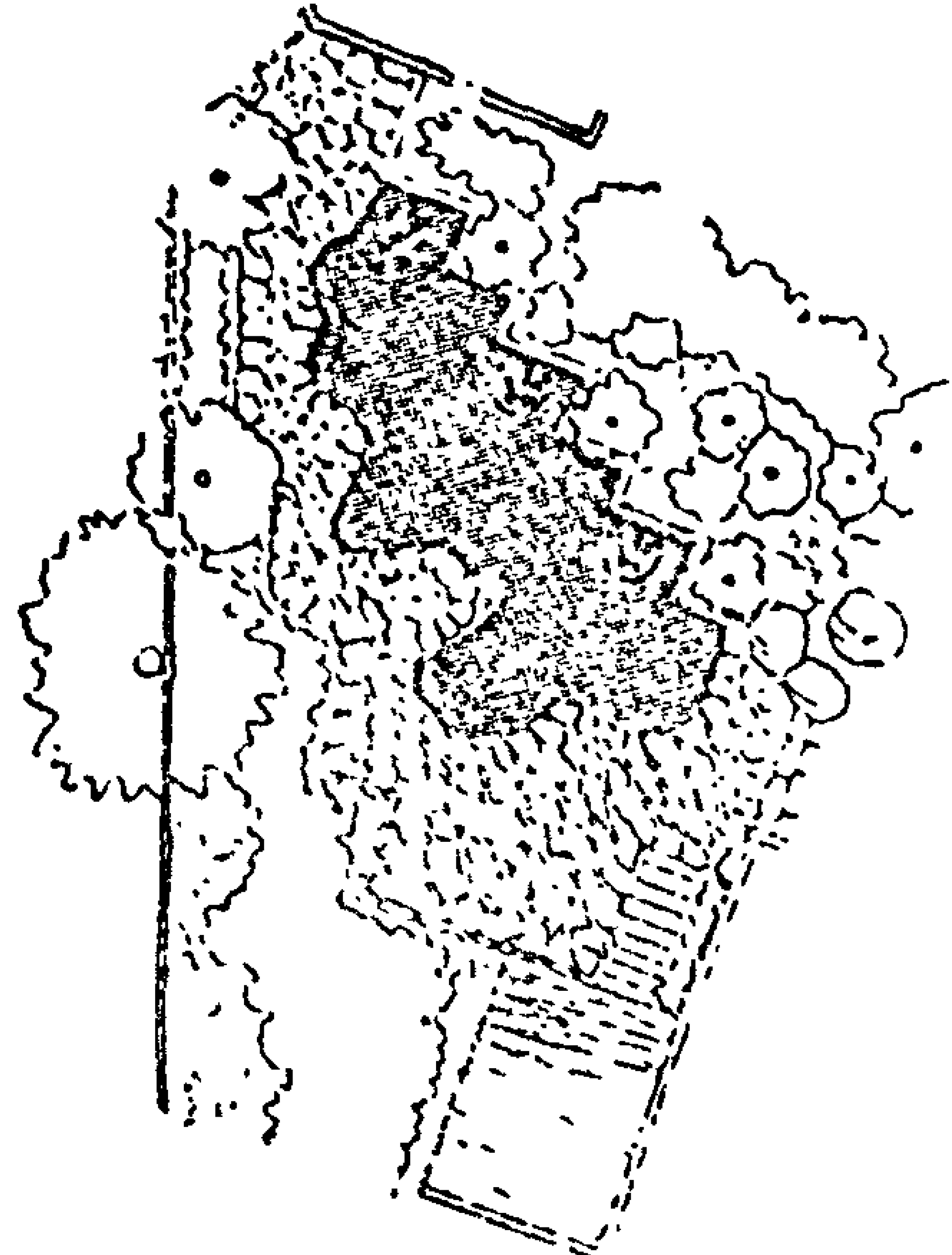
ويحدد هذا الحيز فى الحوض الخاص بما لا يقل عن ثلاثة أمتار حـول محيط الحوض وبارتفاع ثلاثة أمتار .

ويتم توصيل كافة الأجهزة ووحدات الاضاءة داخل هذا الحيز بمحولات الجهد بحيث لا تزيد عن ٢٥ فولت فى حالة الوحدات التى يمكن أن تبلل بالمياه و١٢ فولت للوحدات المغمورة فى المياه

وعلى هذا فان المعدات الخاصة بالحوض يمكن وضعها فى بدروم أسفل المبنى أو جراج قريب من الحوض اذا كان هذا المكان يمكنه تحقيق : وجوده خارج الحيـــز الوقائى وكذلك توافر العمق الذى يسمح بوجود الطلمبة على منسوب اقل من منسوب الحوض . أو حفر غرفة جديدة خاصة بهذه الاجهزة تتوافر فيها هذه الشروط







تشكيلات حرة من الخرسانة المسلحة يفرضها الموقع
(شكل رقم ٦)

For sulfur production a claus process is applied, H_2S is fed to a combustion furnace in which H_2S with O_2 is converted to SO_2 and subsequently partly reacts to S.

The gas mixture is sent through series of reactors in which the remaining H_2S & SO_2 further react over a catalyst bed.

A very important factor for a smooth clause operation is the control of the combustion air ratio with respect to the sour gas feed.

CONCLUSIONS

Natural gas can be used simply as a source of energy but it can also make an ideal feedstock for the production of a variety of petrochemicals such as ammonia and ethylene. The middle east countries are now in a previlaged position to expand their petrochemicals industry and maximization of natural gas local uses. The formulated empirical equation may be a guide for determination of natural gas demand. The natural gas in Qatar is used as fuel and energy source in industrial sector also it is used as feedstock for production of ammonia, urea, ethylene polyethylene and sulfur. These products are almost for export purposes.

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NATURAL GAS UTILIZATION IN QATAR

Natural gas is used as energy source in industrial sector also as a feedstock for the production of many petrochemicals Fig. (1),.

Natural gas is an excellent chemical feedstock for the production of ethylene and ammonia because of its advantages. in capital, energy and operating cost. But in western Europe naphta & fuel oil are used to produce ammonia. Natural gas has a distinct competitive edge over other feedstock (naphta, and gasoil).

The cost of ethylene produced in Arabian(6) Gulf from natural gas is 20.73 cent/Kg where ethylene cost from naphta or gas oil in USA is 38.64 cent/Kg [1].

Ammonia and Urea Production :-

The natural gas (rich in methane) is fed to the ammonia plant. The gas is compressed, introduced to sweetening process. The desulpherized natural gas is reformed with steam where the following equations takes place :



$$CH_4 + 2H_2O = CO_2 + 4H_2 \quad (3)$$



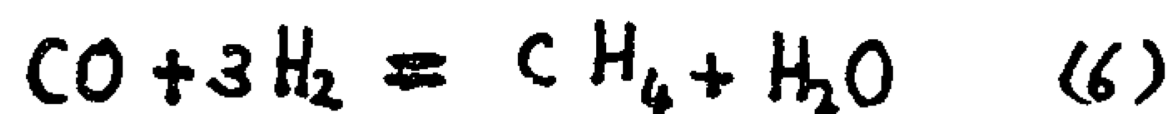
$$C_2H_6 + 2H_2O = 2CO + 5H_2 \quad (4)$$



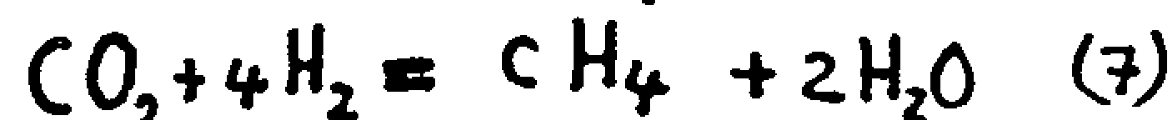
$$C_3H_8 + 3H_2O = 3CO + 7H_2 \quad (5)$$

To a top of secondary reformer process air is introduced. Where N_2 will be available and CO produced in the previous reactions converted to CO_2

CO_2 is removed from process gas and send to urea plant. Any residual CO_2 or CO is converted to CH_4 according to the following reaction.



$$CO + 3H_2 = CH_4 + H_2O \quad (6)$$



$$CO_2 + 4H_2 = CH_4 + 2H_2O \quad (7)$$

The synthesis of ammonia by the reacting of H_2 and N_2 which are present in the process gas favoured by high pressure and low temperature. The reaction does not go to completion in a single pass. Therefore, it is necessary to recycle the unconverted H_2 & N_2 mixture over the catalyst several times. The main consumer of ammonia is the fertilizer industry. Ammonia is also used to produce plastics, resins, fibers and explosives.

The production of urea goes by two reactions

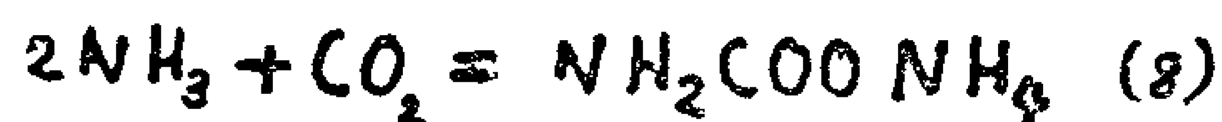
1. The first is the condensation of gaseous NH_3 & CO_2

   $2NH_3$ (g) + CO_2 (g) ....



$$2NH_3 + CO_2 = NH_2COONH_4 \quad (8)$$

2. The second is the dehydration of liquid ammonium carbamate



$$NH_2COONH_4 \rightarrow NH_2CONH_2 + H_2O \quad (9)$$

Ethylene, polyethylene (Low density), Sulfur.



The natural gas rich in ethane is fed to steam cracker. This steam cracker has several indentical pyrolysis furnaces. The cracked gas is compressed, acid constituents are removed. Ethylene is separated from the unreacted ethane and higher boiling point products.

The highly purified ethylene is fed to a stirred autoclave reactor. Where ethylene is compressed to 2000 bar and in presence of catalyst at temperature approximately 160C. The effluent from reactor passes to a separator vessel, in which uncoverted ethylene is removed and recycled.

1971. It has an area of 6000 Km^2. North field contains 150 trillion cubic feet of proven natural gas reserves (7). The size of this field is therefore adequate to support the (LNG) prospect and the pipline system for export.

The development of the North field will form a major part of Qatar's economic future for many years. It will satisfy the following:

1 — The domestic industrial demand for fuel.

2 — The requirements of neighboring countries of the cooperation council of the Arab States of the Gulf.

3 — The export of condensate naphta and liquefied petroleum gases (LPG's).

4 — The fuel for the (LNG) export project.

5 — It could also form the basis for possible pipeline supplies to Europe, which are presently being investigated.

In Qatar the (NGL1) plant is operated for onshore stream and (NGL2) is operated for offshore stream.

The NGL Plants are designed to Produce :

1) Methan rich gas, part of it is consumed as fuel through the state gas distribution system, the remainder as feedstock in fertilizer industry Fig. (1).

2) Ethane rich gas, which is utilized as a raw material to produce ethylene, and low density polyethylene.

3) Propane and butane, which are the (LPG) products.

4) pentane + condensate "Natural gasoline" which is a highly volatile mixture and is normally added to motor gasoline to raise its vapour pressure and increase the ease of starting in cold weather.

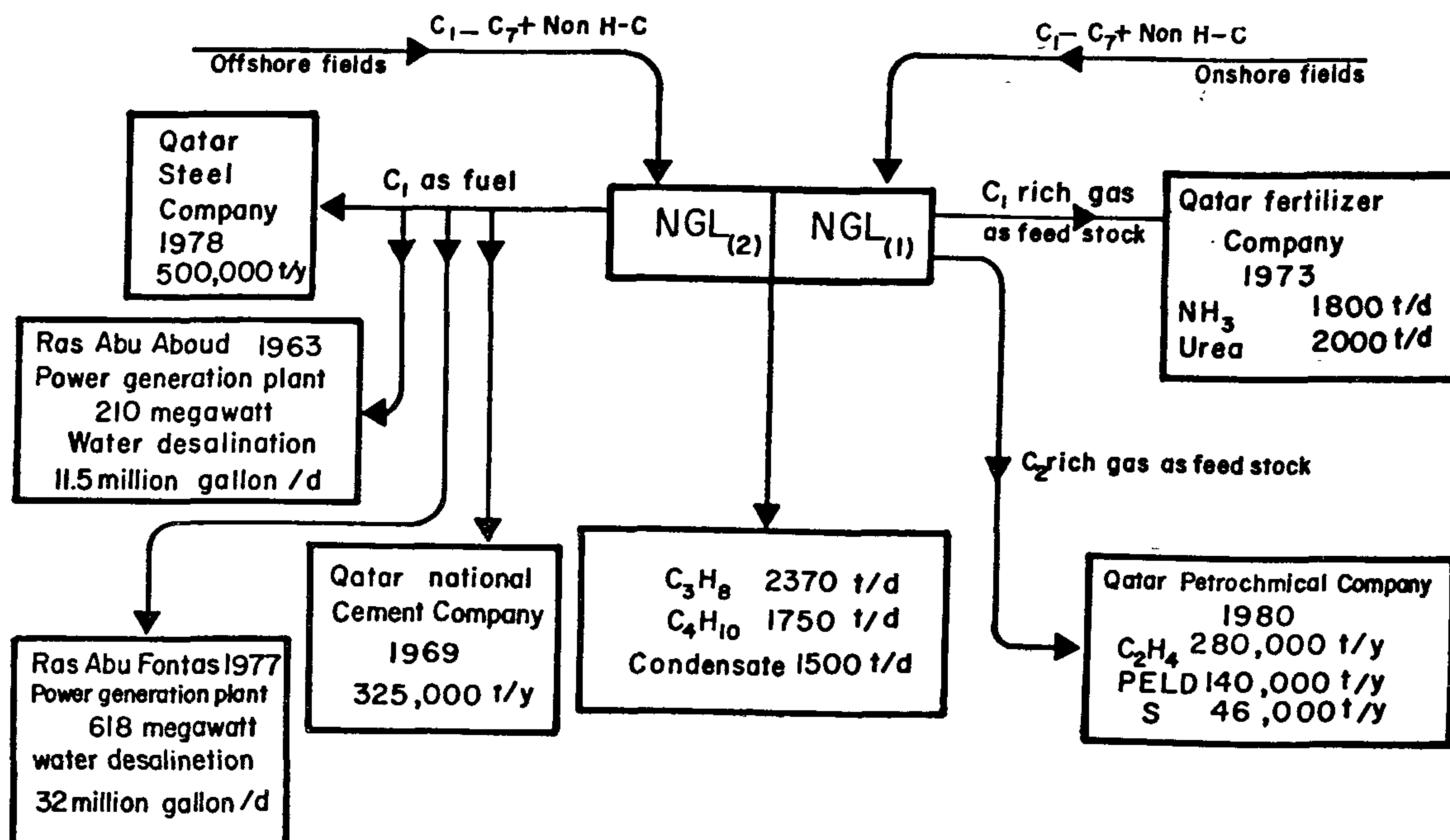


Fig. (1) Natural gas distribution and utilization in State of Qatar.

on vapor pressure and other component physical properties. There are commonly called natural gas liquids (NGL). If the effiuent gas from (NGL) plant is totally liquified, it is called liquified natural gas (LNG).

NATURAL GAS DEMAND (NGD)

Any consideration of the future scope for natural gas usually starts from an examination of known resources. The simplistic approach is to asses world natural gas reserves in relations to current rates of production. In this regard, on the basis of world reserves, and the present production ratio. the life cycle for natural gas is therefore about 50 : 1.

According to the published data (5,6) in literature (1974 - 1984) on natural gas production, consumption, and proven reserves a table 4 could be formulated. Therefore, it is possible to write an emperical equation based on the table (4) and basic information.

Table 4 THE C/P RATIO AND PROVEN RESERVES OF NATURAL GAS DIFFERENT COUNTRIES

Country	(C/P) 1974	(C/P) 1984	Proven reserves Chare of Totals as %
North America	0.97	1.02	8.5
Latin America	0.88	86.00	5.4
Western Europ	1.10	1.25	6.1
Middel East	0.75	1.02	25.6
Affrica	0.4C4	0.66	5.5
Japan	2.69	23.60	0.2
Centrally Planned Econnomics (CPE's) -China, USSR	0.93	0.98	44

NGD = (1/Cg) (C/P) (Tf) (Po/Pg) (2)
Where :-

Cg: is the cost of gas which include production, gathering system, treatment, sulfur recovery, dehydration, transmission and compression. By improving the technology the gas cost could be decreased.

(C/P) consumption : production ratio, could be evaluated in certain areas e.g. USA, Latin America, Western Euorpe, Japan, and Africa. Middle East & Centrally planned economics (USSR, China) are excluded due to high % of proven reserves.

(C/P) could be affected by OPEC decision for the reduction of oil production.

Tf is the trade factor. The parameters affecting trade factor could be implementation of programs for natural gas utilization especially in dense populated countries, utilization of (LNG) for electric power generation in different countries, decreasing transport cost, and economic growth.

(Po/Pg) : is competition factor, since the demand for gas depend essentially on the future behaviour of oil prices.

(Po/Pg) = (Price of heating unit produced from oil) / (Price of heating unit produced from gas).

Therefore, (NGD) increased by increasing C/P ratio. (Tf) and (Po/Pg) and also decreasing Cg.

NATURAL GAS IN QATAR

The «Dukhan Khuff» onshore gas reservior is currently the main gas producing reservior in Qatar. The «Dtkhan Khuff» onshore associated gas reservior is located on the west coast of Qatar. The associated natural is also produced from $Edd El-Sharqi, Maydan Mahzam and Bul Hanine» offshore oil fields.

Qatar's North field could be the biggest non-associated gas reservior (offshore) in the world. This fields is discovered in

In sulfinol - M process. MDEA (methyl - di - ethanol - amine) is applied instead of DIPA (di iso propanol amine).

In comparison with the former process, the amount of circulating solvent can be reduced by 40% for certain applications while the steam consumption for regeneration can also be reduced by 30% (4). The typical natural gas specification (4) described in table. 3.

TABLE 3 THE TYPICAL NATURAL GAS SPECIFICATIONS

Component	Natural Gas	Natural Gas for LNG
H_2S, P.p.m.v	3	3
CO_2, P.p.m.v	1-2%	50-100
Total S, COS, mg/nm	100-150	100-150
RSH		
CS		
RSR		
H_2O Dew point, C	-5	-150-160
HC Dew point, C	-2	-40-50

Some or all of the following constraints must be considered for natural gas sales.

1 — Water content.

2 — Maximum hydrocarbon dew point.

3 — Sulfur content.

4 — The specified heating value.

5 — Solids content.

6 — Effluent free of liquids.

Natural Gas Liquids Recovery:

There are several alternatives. One is total liquefaction Another is partial liquefaction. In this latter case, the liquids evolved may be sold as «unfinished» or «semifinished» as crude or fractionated at the site into fluid fraction that posses specified individual characteristics required for direct sale.

Liquefaction (total or partial) always involves control of pressure, temperature and system composition to obtain the right amount and the right kind of liquid Design consists of providing these conditions at a proper level plus sufficient area so that the mass transferring between phases may do so in the time available. The basic computational tools are phases behaviour principles, flash calculations, mass and energy balances and mass transfer consideration.

The liquid produced from gas is fixed by the behaviour of vapour-liquid equilibrium or the so called, equilibrium vaporization ratio, K

This is defined as:

$$K = (Yi/Xi)$$

Yi — mole fraction of any component in the vapor phases.

Xi = mole fraction of any component in the liquid phases.

At pressure up to 60 psia, where ideal gas concepts apply, vapor pressure may be used to find equilibrium behaviour.

At equilibrium:

The rate of vaporization = rate of condensation

Partial pressure (vapor phase) = P Yi

Partial pressure (liquid phase) = Pv Xi

Where

Pv = vapor pressure of any component at the P & T of separation

At equilibrium:

$$P\,Yi = Pv\,Xi \text{ or } K = Pv/P \qquad (1)$$

All other liquid products are result of a fractionation which separates a raw mixture into its components parts based

Table 2. Physical Properties of Natural Gas Components.

Hydrocarbon		Specific Gravity	Boiling Point, °C	Calorific Value Btu/cf	Carbon/ Hydrogen (by weight)	Critical Temperature °C	Critical Pressure Atm.
Name	Formula						
Methane.	(CH4)	0.554	-161.5	1100	3.0	-82.3	46.5
Ethane	(C3H6)	1.049	-88 6	1800	4.0	32.2	48.3
Propane.	(C3H8)	1.562	-42.1	2300	4.5	96.8	42.1
Isobutane.	(C4H10)	0.557	-11.1			13.5	36.5
				2940	4.8		
n-Butane	(C4H10)	0.579	-0.5			152.3	37.0
Isopentane	(C5H12)	0.6211	27.9			187.8	32.0
					5.0		
n-Pentane.	(C5H12)	0.626	36.1			197.0	33.1
n-Hexane	(C6H14)	0.659	68.7		5.1	234.5	29.9
n-Heptane.	(C7H16)	0.684	98.4		5.25	267.0	26.9

It is necessary to adjust the humidity of natural gas to prevent hydrate formation. Hydrates are solid, white compounds formed from the reaction between water and the hydrocarbon gases under the pressures and temperatures normally used in gas pipelines. Water is removed by treatment of the gas with various alcohol or glycols such as ethylene glycol, also by use of solid adsorbent such as silica gel or molecular sieves. Glycol solutions for dehydration are used because of reliability of operation and low cost for both chemicals and utilities.

When natural gas contains an appreciable amount of hydrogen sulfide and carbon dioxide is called sour natural gas (3). These acidic gases are responsible for many corrosion problems.

The removal of hydrogen sulfide and carbon dioxide from the sour natural gas (sweetening) by the current technology has been done by:

1 — Iron sponge or molecular sieves.

2 — Chemical absorption process using amine or potassium carbonate solution.

3 — Physical absorption process.

4 — Direct conversion.

5 — Gas membranes.

The chemical absorption by using solvents is widely used. Recently there have been many new developments in gas sweetening processes practically all developments aim at reducing the energy consumption. This is particularly the case for the amount of absortion solvent to be circulated in order to reach a certain H_2 removal rate. Also attempts are made to reduce the steam consumption during regeneration e.g. by applying new solvents that have a smaller binding force between the absorbed components (H_2 & CO_2) and the solvents, so regeneration will require less energy.

Also natural gas has been used as fuel for transportation, currently, above half a million vehicles of different types are running either on compressed natural gas (CNG) or on liquefied natural gas (LNG) in a number of countries, including Italy, New Zealand, U.S.A., Australia, Iran and France [2].

Natural gas can be used to supply the energy necessary to energy - intensive industries such as aluminium smelting, production of steel, cement, glass and water desalination.

It is also considered as a feedstock to produce Petrochemicals such as ammonia and ethylene.

Like crude oil and its derivatives, natural gas can be across borders by pipeline. It may also be processed using modern technologies to yield Liquified Petroleum Gases (LPG), Liquid Natural Gas (LNG), Natural Gas Liquids (NGL), which can then be transported by special tankers oceans to distant markets.

Natural gas is attractive in certain sectors, but its peneteration of the transport sector is severilly restricted by a technological barrier. The limitation on international gas trade arise from high transport cost, and high capital cost. Moreover, the ability to store gas in the market place is limited and costly compared with oil. The unit of heat delivered from natural gas is tchnically more costly and difficult to transport than oil.

Gas conditioning :

Once the gas has been separated from the oil, it needs to be collected and treated. A detailed accurate analysis of the gas is necessary the main reason for requiring accurate hydrocarbon composition data. The prediction of phase behaviour which can show whether a particular stream will be all gas, all liquid or a two phase gas liquid system and, if the latter, what are the proportions of liquid and gas, the compositions of the two phases and the effect of temperature and pressure on the proportional and compositions of phases. Composition of various natural gases is shown in table (1). Also the physical properties of natural gas components is given in table (2).

TABLE 1. Composition of Various Natural Gases.

Component	Salt Lake U.S.	Webb Texas U.S.	Kliffside U.S.	Sussex England	Lacq France	Lybia	Saudi Arabia Abqaiq	Iran	North Sea	"Typical"
Methane	95.0	89.4	65.8	93.2	70.0	66.8	62.24	74.9	85.9	51.06
Ethane	0.8	6.0	3.8	2.9	3.0	19.4	15.07	13	8.1	18.52
Propane	0.2	2.2	1.7	....	1.4	9.1	6.64	7.2	2.7	11.53
Butanes	....	1.0	0.8	....	0.6	3.5	2.40	3.1	0.9	4.37
Pentanes & heavier	....	0.7	0.5	....	....	1.2	1.12	1.5	0.3	2.14
Hydrogen sulfide	....	....	....	1.0	15.0	....	2.80	....	....	2.20
Carbone dioxide	3.6	0.6	....	2.9	10.0	....	9.20	0.3	1.6	9.68
Nitrogen	0.4	1.0	25.6	....	....	....	....	....	0.5	0.50
Helium	....	....	1.8	....	....	....	....	....	....	....

ASPECTS FOR NATURAL GAS UTILIZATION

Dr N. ABDELMONEM

Abstract

World reserves of natural gas continued to increase whilst commercial production remained almost steady. There were improvements in natural gas utilization and some growth in international trade. Substantial reserves in many countries are expected to be developed for domestic use.

There many suggestion for most countries with available gas reserves. For example maximisation of local uses so as to reduce the need to import oil, or in oil exporting, so as to release more oil for export. After setting aside sufficient reserves to satisfy long term local needs. Consider export prospects for any surplus gas or consider prospects for conversion to other products.

This paper attempts to review some basic information on natural gas conditioning and utilization, also to formulate an empirical equation to determine the natural gas demand. Finally state of Qatar is considered as a case study for natural gas utilization.

INTRODUCTION

Natural gas, as the term is used by the petroleum industry, is a mixture of gaseous hydrocarbons C1 — C7 with methane as the major constituent. It usually contains small amounts of non-hydrocarbon gases such as hydrogen sulfide, carbon dioxide, mercaptan, water, radon 22, helium and nirogen.

Natural gas is found in porous reservoirs associated with crude oil, associated gas, or in gas reservoirs with no oil present, non associated gas. Associated gas can be either flared, rejected or utilized as a raw material for chemical processes.

The total world proven reserves of gas are estimated at about 90.6 trillion cubic meter in 1983 [1]. Natural gas supplied 19% of world primary energy consumption and third in the fuel list after oil and coal.

Natural gas is an important raw material which has great value both as an energy source and as a feedstock for the petrochemicals. As a clean fuel with a very little emission when it burns, in so far as pollution is concerned. Gas is superior fuel from an environmental point of view. It can be carried in bulk (say, by pipe) or in small amounts (say, in metal bottles) to the place of use. Therefore, it may be used to satisfy domestic energy needs such as space heating, cooking and the generation of electricity.

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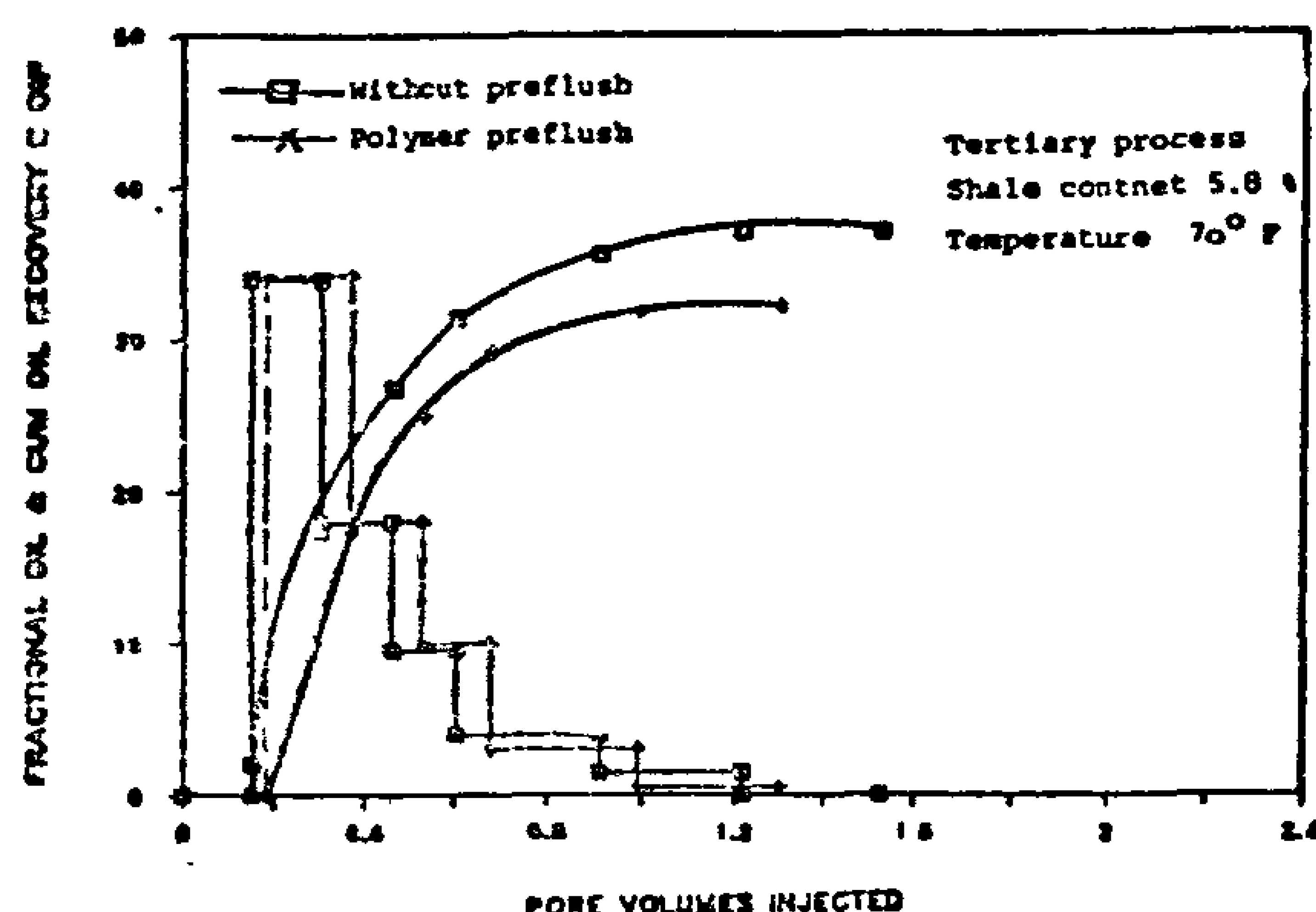


Fig. 10 Effect of polymer preflush on production history-tertiary oil recovery process.

Sayyouh(32) mentioned that preflushing with a polymer solution will result in a decrease in surfactant adsorption and hence, increase oil recovery. However the existence of the shale will reverse these results, due to shale swelling which increases boh the inaccessible pore volume and polymer entrampment which causes plugging of the smaller pore space.

Polymer entrapment could be a primary reason for oil recovery reduction in both secondary and tertiary oil recovery.

It was determined that polymer adsorption is sensitive to salt. Adsorption of the polymer increases with increasing salt concentration (32). Therefore, the high connate water salinity (370,000PPM) should increase polymer adsorption which, in turn,increase the pore plugging and hence, reduce secondary oil recovery.

Sulfonate-polymer incompatibility was investigated by Turshenski (34) and is considered to be a reason for reducing tertiary oil recovery. Turshenski, stated that a micellar solution can be invaded by the polymer (if the concentration is great enough) in the preflush to allow for two phase to occur. When the interfacial tension between these two sulfonate-containing phases is, sufficient, one will be trapped in the porous media and this will result in reducing oil displacement efficiency.

Fig. 11 summarizes the effect of preflush on oil recovery in secondary and tertiary processes. As shown from this figure, oil recovery decreases when using either NaOH or polymer for tertiary recovery processes.

CONCLUSIONS

Based on the results of this investigating the following conclusions have been obtained:

1 — Absolute permeability decreases with increasing shale content up to 1.5%; thereafter, a little change in permeability with further increase in shale content above 1.5% was obtained. Sandpack porosity gradually increases with increasing shale content to 1.5%. Small changes in porosity result with further increase in shale content.

2 — The contact angle increased with shale content up to 1.5%; thereafter, the angle decreased with further increase in shale content.

3 — Oil recovery decreases with increasing shale content to 1.5%. Recovery then began to increase as shale content was increased from 1.5% to 3.0%. At shale content greater than 3%, little change in oil recovery was observed.

4 — Relative permeability ratios are directly affected by shale content. Kro/Krw decreases with increasing shale content up to 1.5%. Kro/Krw improved with further increase in shale content.

5 — Based on the actual shale content of Sidki oil reservoir (5.8%):

a — Oil recovery increases with increasing temperature up to 120°F, but then decrease with further increase in temperature.

b — Tertiary oil recovery is decreased using either a NaOH slug preflush prior to waterflooding or a polymer as a secondary process.

The phase separation of a micllar solution, adsorption of sulfonate, and polymer degradation, which occurs at temperatures higher than 150° F have proven the main reason for recovery reduction. Again it must be noted that the recovery at 200° F is still higher than at 70° F due to the overriding effect of reduction in oil viscosity.

Effect of Preflush on Micellar Flooding in The Presence of 5.8% shale Content :

Different methods have been suggested for reducing surfactant loss by adsorption. These methods include using a preflush with a sacrificial agent such as polymer or sodium hydroxide solution. It was observed in some cores tested (32) that less adsorption occurred in the presence of polymer solutions. The reduced sulfonate adsorption in presence of a buffer solution is a desirable phenomenon from the view point of sulfonate conservation and integrity of the surfactant slug.

Preflush with Sodium Hydroxide :

Variations of the production history for tertiary process with the preflush with 15% PV NaOH slug of 1% concentration are shown in fig. 8. The NaOH preflush has a greater effect on tertiary oil process As shown from this fig., less oil recovery was obtained by preflushing the core with NaOH.

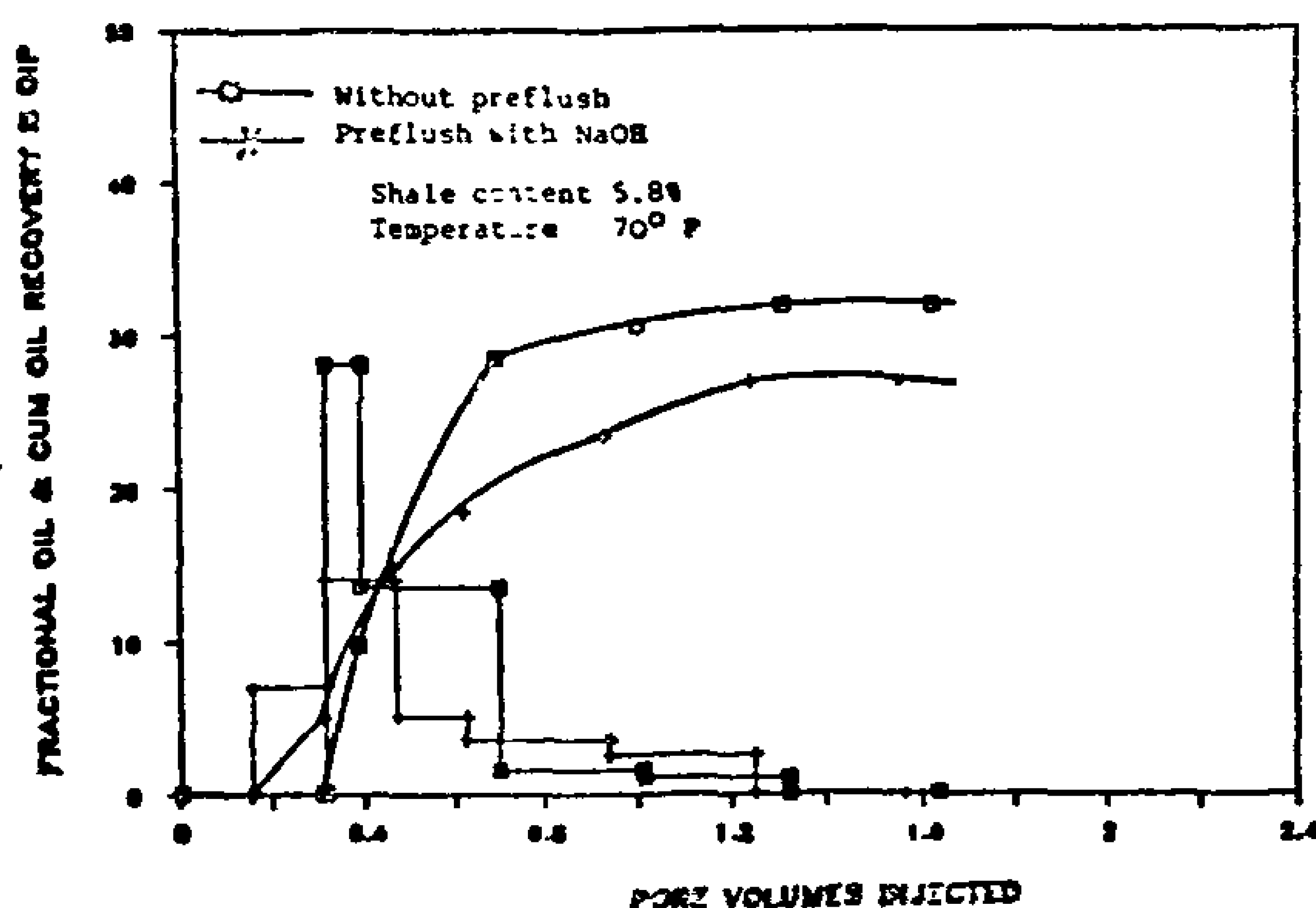


Fig. 8 Effect of preflush with NaOH on production history-tertiary oil recovery process

Latil (33) stated that the swelling of shale is PH sensitive, an acid water can give rise to a contraction of the shales. Therefore, alkalines increase the swelling of the shale.

The increase of shale swelling will further decrease the permeability resulting in a reduction in oil recovery. Shale swelling will further increase the inaccessible pore volumes (IPV). As the IPV increase the entrampment of polymer increases, thereby decreasing the displacement efficiency and hence, decreasing oil recovery.

Preflush with Polymer:-

Two runs were performed one at 70°F and the other at 200°F to study the effect of polymer preflush on oil recovery using 5.8% shale content of Sidki formation. Polymer pusher 500) was added to sea water with 500 PPM concentration. This solution was used for waterflooding.

The effect of the polymer preflush on the production histories for tertiary process at 70°F and 200°F are shown in figs 9, and 10, respectivelly. Preflushing with polymer decreases the oil recovery in both cases. The oil-water bank B.T. decreases by using a polymer preflush at 70°F but increases at 200°F. Also oil recovery increases with temperature in the tertiary process.

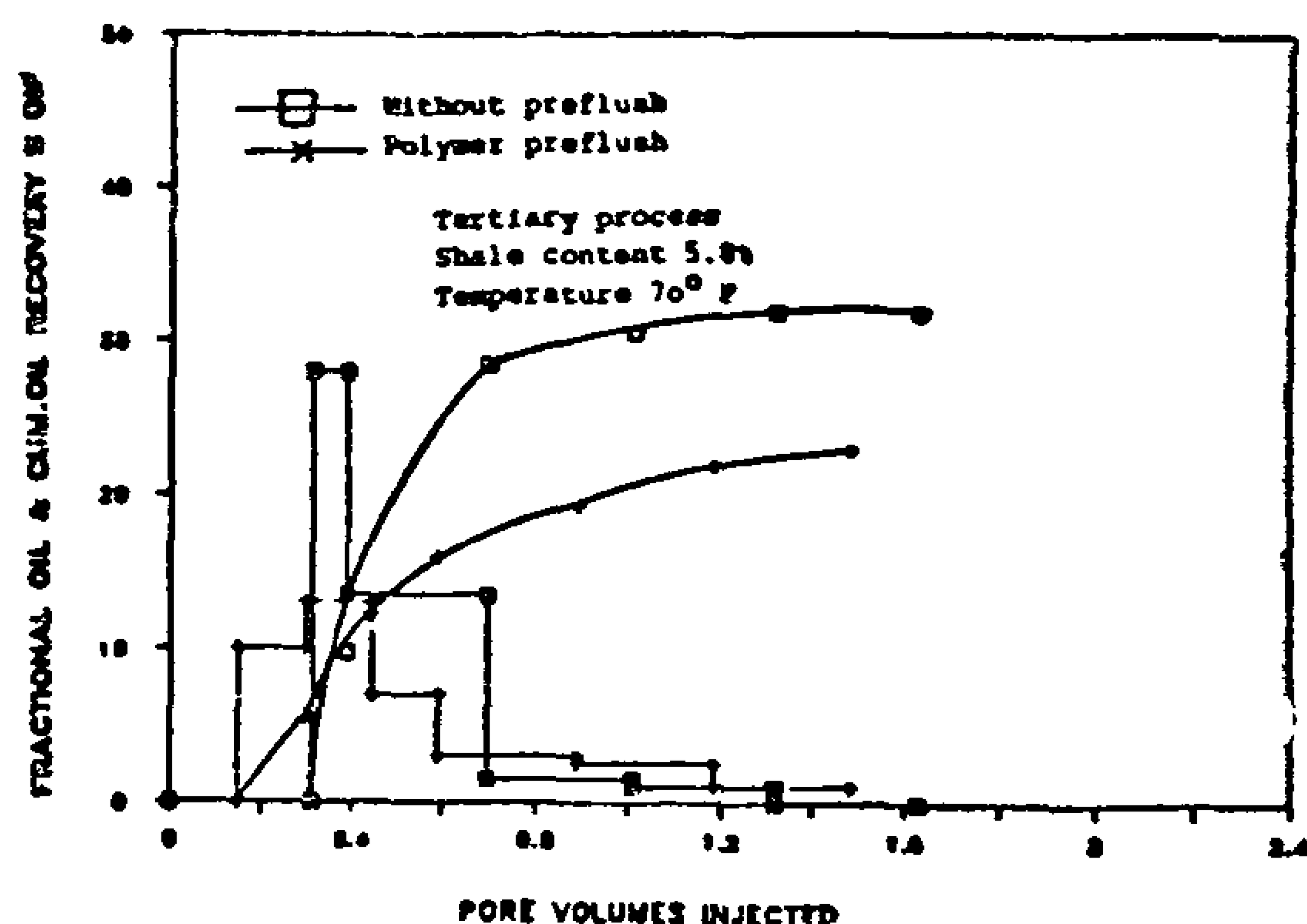


Fig. 9 Effect of polymer preflush on production history-tertiary oil recovery process.

This reslut is in general agreement with surfactant losses reported by Gale and Sandvix(23) on pure clay minerals. Malmberge and smith also studied the effect of montmorillonite on oil recovery and the results showed that minimum oil recovery was obtained when using Cottage Grove core (1.54% montmorillonite). Malmberge and Smith's(22) results are further substantiated by the results obtained in this investigation.

The variation of oil-water relative permeability ratio (Kro/Krw) as a function of water saturation is shown in fig. 6. The oil-water relative permeability ratio increases with increasing shale content up to 0.75% then decreases again up to 3%. Above 3% increasing shale content will improve Kro/Krw. This due to the adsorption of surfactant on clay surfaces will decrease displacement efficiency resulting in increasing the mobility of equeous phases and hence its permeability.

Effect of Temperature on Oil Recovery

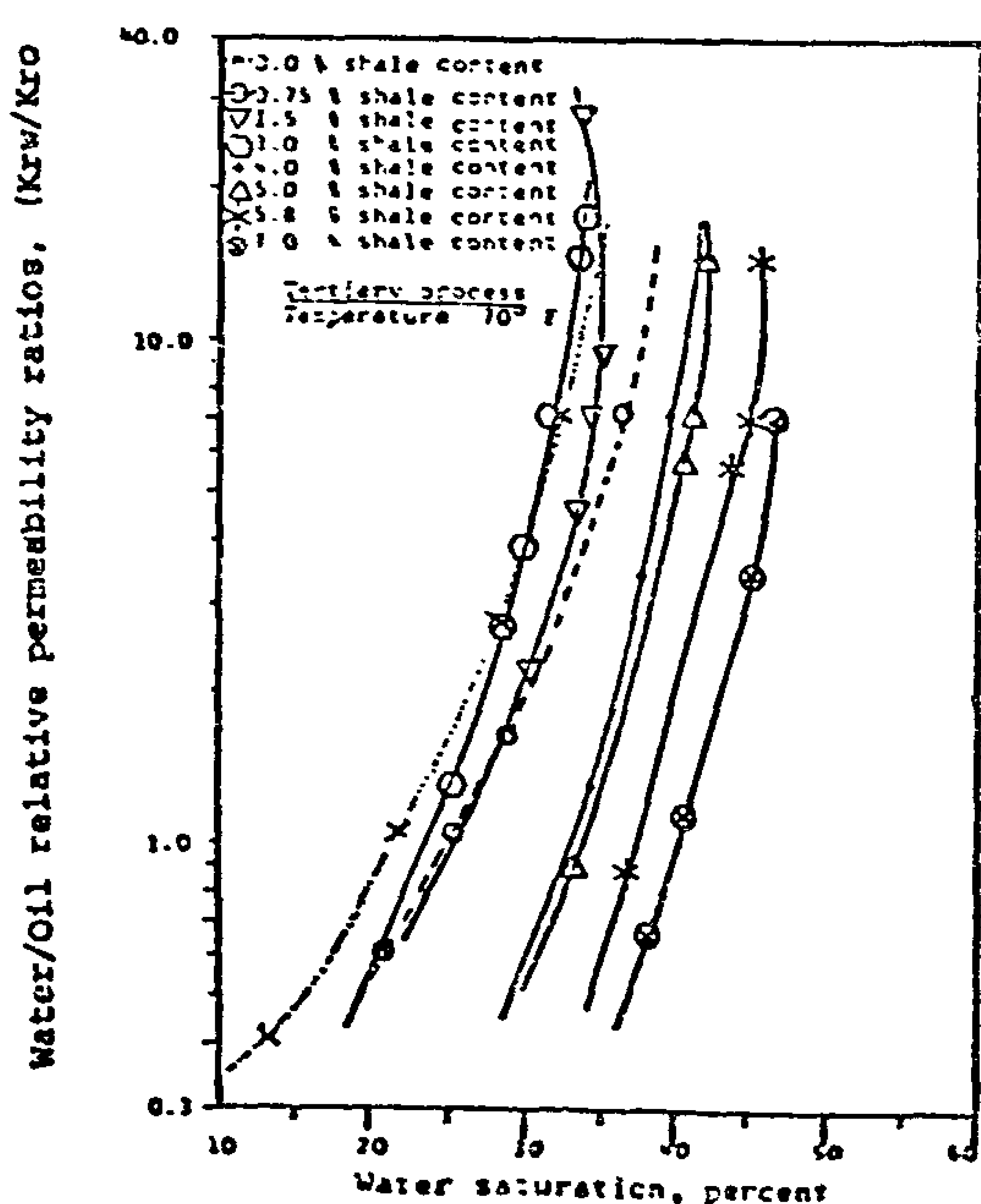


Fig. 6 Effect of Shale Content on Water/Oil Relative Permeability Ratios Vs Water Saturation.

The effect of temperature on the cumulative tertiary oil recovery is shown in fig. 7. Oil recovery increases with increasing temperature up to 120°F, and then decreases with further increase in temperature to 200° F, However, as shown, the cumulative oil recovery at 200°F is still greater than the recovery at 70° F.

Increasing temperature can determentally affect surfactant floods. Early investigation indicated that at very low surfactant concentration, the surfactant adsorption decrease with an increase in temperature (24-28). Ziegler and Handy (29) Studied the effect of temperature on anionic and nonionic surfactants and found that at higher surfactant concentrations the adsorption increases with increasing temperature. Further, they observed that anionic surfactant precipitation occured at 110°C. Also Dauben and Froning (30) have shown that, depending on the salt concentration, phase separation can occur at 150° F with a solution that is stable at room temperature. Also the degradation of polymers which used for mobility control can occur as temperatures increase above 140° F. Knight (31) evaluated and presented this effect on polyacrylamides.

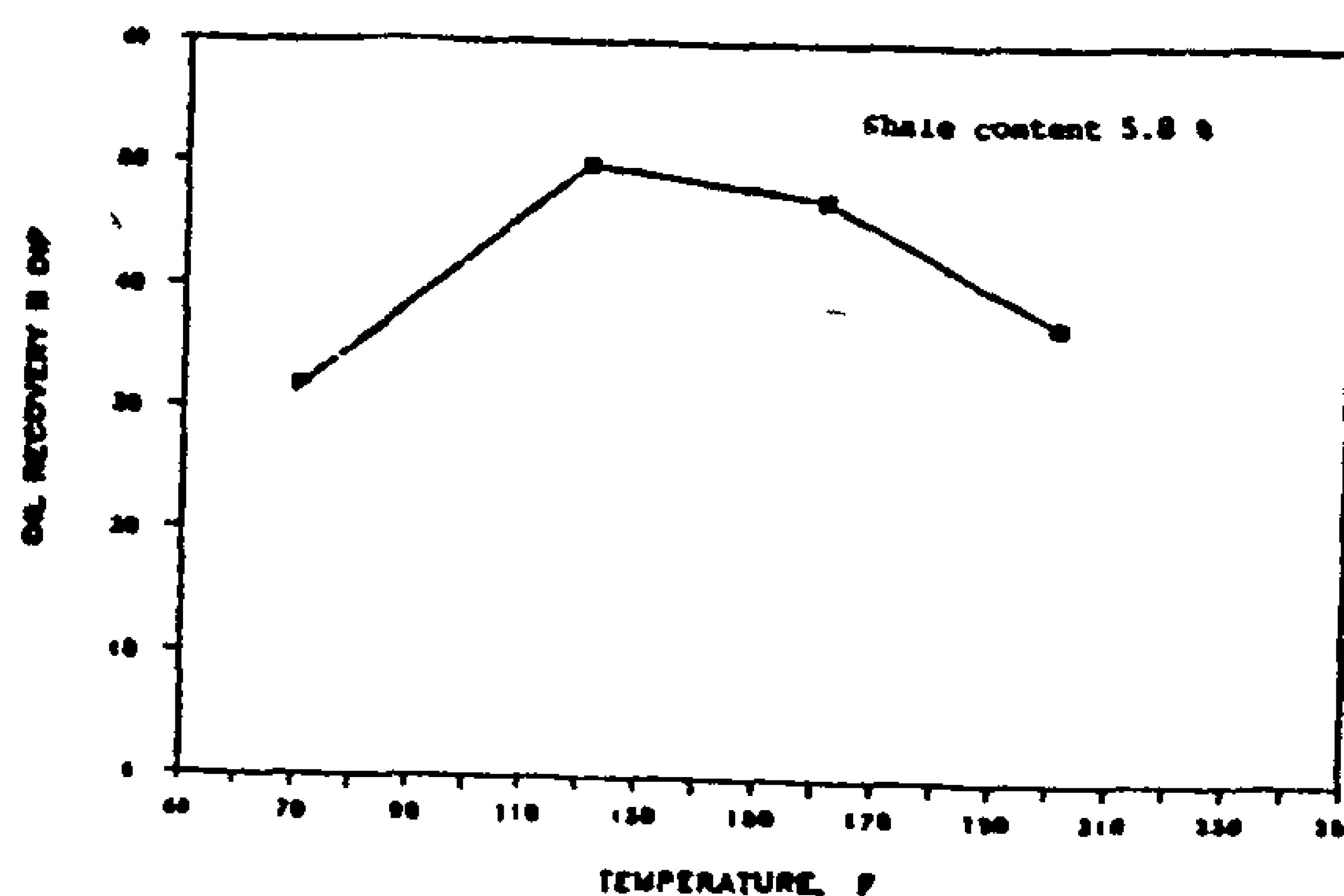


Fig 7 Effect of temperature on tertiary oil recovery

Table 7 Summary of Results

RUN No	SHALE CONTENT	PORE VOLUME	POROSITY %	OIL IN PALCE %	CONNATE WATER %	Kab DARCY	SECONDARY RECOVARY	TERTIARY RECOVARY	TEMPERATURE °F	REMARKS
1	0.00	313	9.84	79.00	21.00	19.150	72.3	65.7	70	10 % PV SLUG
2	0.75	319	10.03	70.22	29.78	23.900	72.7	51.4	70	" " "
3	1.50	324	10.18	66.00	34.00	3.100	56.1	15.4	70	" " "
4	3.00	310	9.75	71.60	28.40	6.100	65.8	30.9	70	" " "
5	4.00	319	10.03	62.70	37.30	0.770	64.8	29.8	70	" " "
6	5.00	305	9.59	62.30	37.70	2.755	65.8	30.0	70	" " "
7	5.80	322	10.10	58.70	41.30	1.750	61.9	31.9	70	" " "
8	7.00	285	8.96	57.54	42.46	1.360	64.3	31.6	70	" " "
9	5.80	294	9.20	56.00	44.00	3.789	64.2	50.0	120	" " "
10	5.80	304	9.60	59.00	41.00	1.898	60.6	47.2	160	" " "
11	5.80	326	10.20	57.40	42.60	1.889	48.1	37.1	200	" " "
12	5.80	329	10.30	59.60	40.40	1.709	62.0	23.5	70	5 % PV SLUG
13	5.80	320	10.10	57.80	42.20	1.826	60.3	42.2	70	20 % PV SLUG
14	5.80	320	10.10	56.60	43.40	0.803	61.0	27.0	70	PREFLUSH WITH Na OH
15	5.80	337	10.60	60.20	39.80	1.847	53.4	23.0	70	PREFLUSH WITH POLYMER
16	5.80	322	10.10	64.60	35.40	0 824	43 3	32.2	200	" " "

As stated previously, adsorption is a major factor in determining oil recovery using micellar solutions. Adsorption of surfactant on the surface of porous media will result in loss of miscibility. If adsorption occurs it may be difficult to maintain the desired lower values of IFT and mobility control. It is also a major cause of surfactant slug breakdown. Consequently, surfactant adsorption on the grain surface can greatly influence, the efficiency, and economics of oil recovery.

One of the major force causes adsorption is the electrostatic attraction between two opposity charged surfaces. Clay minerals are negatively charged under most natural conditions mainly due to substitutions. It is to be noted by Hanna (21) that the charge on clay surface are PH dependent, and at the point of zero charge (PH at which the net charge of mineral surface is zero) of clay both the sides and faces will be charged and thus posses adsorptive properties that other minerals might not posses at their points of zero charge.

Malmberge and Smith (22) studied the adsorption of surfactant on Berea sandstone, Seelingson, Cottage Grove, and South Texas cores. The minerallogy of these cores were presented in Table 8. A summary of their results are also shown in this Table. As shown from this table, as Kaolinite content decreases and montmorillonite increases, surfactant loss increases. Surfactant adsorption increase with montmorillonite up to 1.5% (Cottage Grove core), then decreases again with further increase in montmorillonite up to 6.65% (Seeligson core), then increases again with montmorillonite increasing.

Table 8 Malmberge et al (22) Results

Core Type	Minerals		Adsorption lb/acre-ft	Retention lb/acre-ft	Oil recovery
	Mont.	Kaolinite			
Berea	0.1	7.38	900	900	[illegible]
Seeligson	6.65	0.82	11600	1540	51 %
South Texas	8.52	0.7	10000	1240	82 %
Cottage Grove	1.54	9.47	12000	1000	42 %

representing the matrix. The concentration of the matrix is same in all samples, and hence it will have the similar effect on the wettability measurement.

The contact angle as a function of shale content is shown in fig. (4) As shown in this figure, all the cores are water-wet with the minimum contact angle obtained at zero% shale content. The contact angle increases with increasing shale content up to a maximum value at 1.5% shale content. The contact angle then decreases with further increases in shale content above 1.5%. However, the contact angle at 7% shale content is still higher than that at zero shale content.

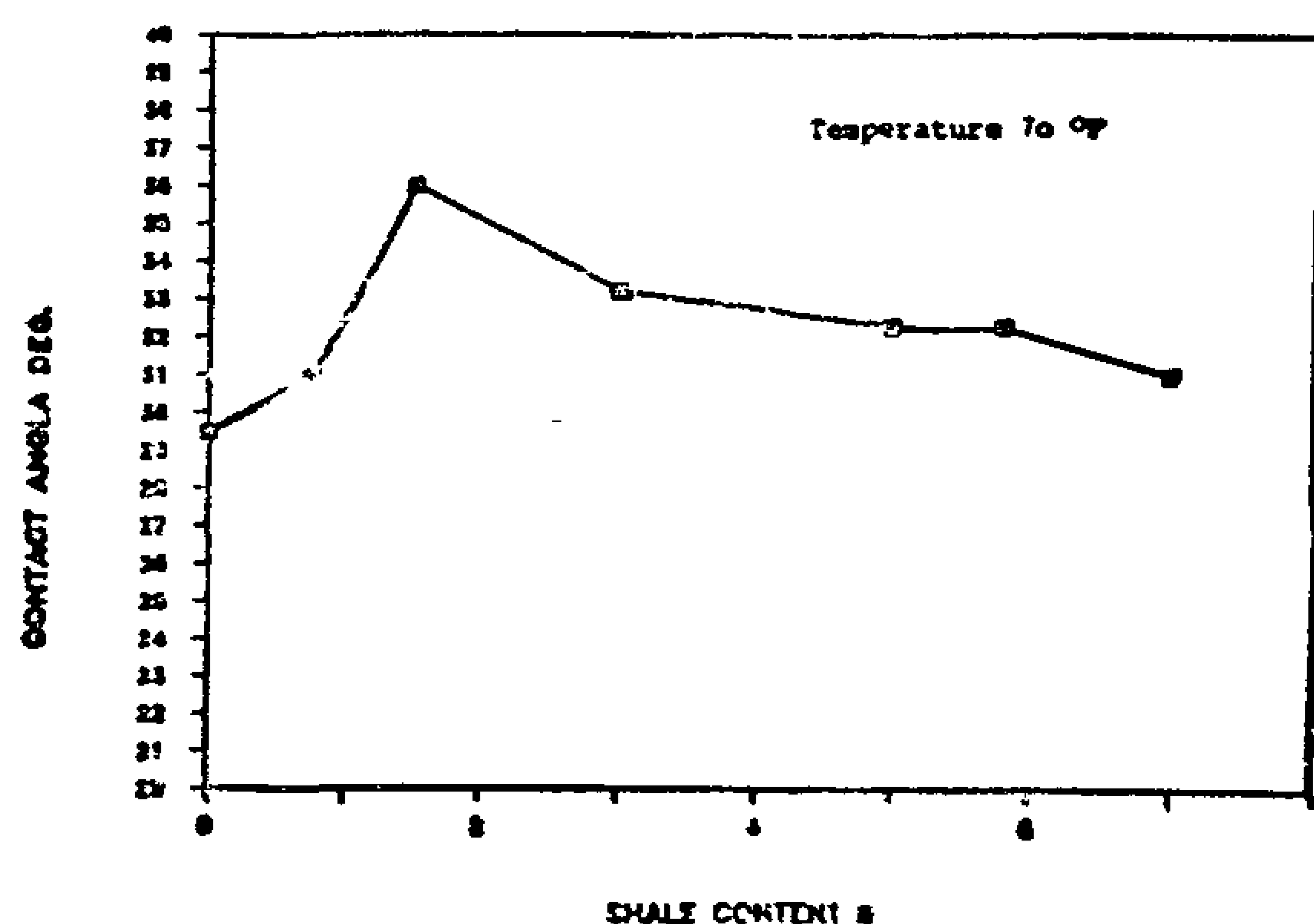


Fig. 4 Effect of shale content on contact angle.

The surface forces in a solid-water-oil system are related by Young-Dupree (20) equation which states that

$$\propto - DE = \sigma_{wo} \text{ Cos } \Theta$$

Where DF is free energy required to displace oil from rock by water. This equation shows that, at a constant IFT between oil and water (σwo), as COS Θ increases the left hand side of the equation decreases and hence oil recovery increases. Therefore, greater oil recoveries will be obtained at lower contact angles. The little contact angle at low shale content results in the highest oil recovery. Minimum oil recovery was obtained at the maximum contact angle for the sample having 1.5% shale content. As shown an improvement in the oil recovery was obtained when the contact angle was then decreased with increasing shale content above 1.5%.

Effect of Shale Content on Tertiary Oil Recovery :

The Effect of shale content on tertiary oil recovery is shown in fig. 5. A summary of the displacement runs is presented in Table 7. A cumulative oil recovery of 65.7 % OIP was obtained at 0.0% shale content. Cumulative oil recovery then decreases with increasing shale content up to the minimum value at 1.5% shale content. (The same effect as in secondary recovery). From 1.5% to 3% shale content, oil recovery gradually increases. After 3% shale content, no measurable change in oil recovery was obtained with increasing shale content.

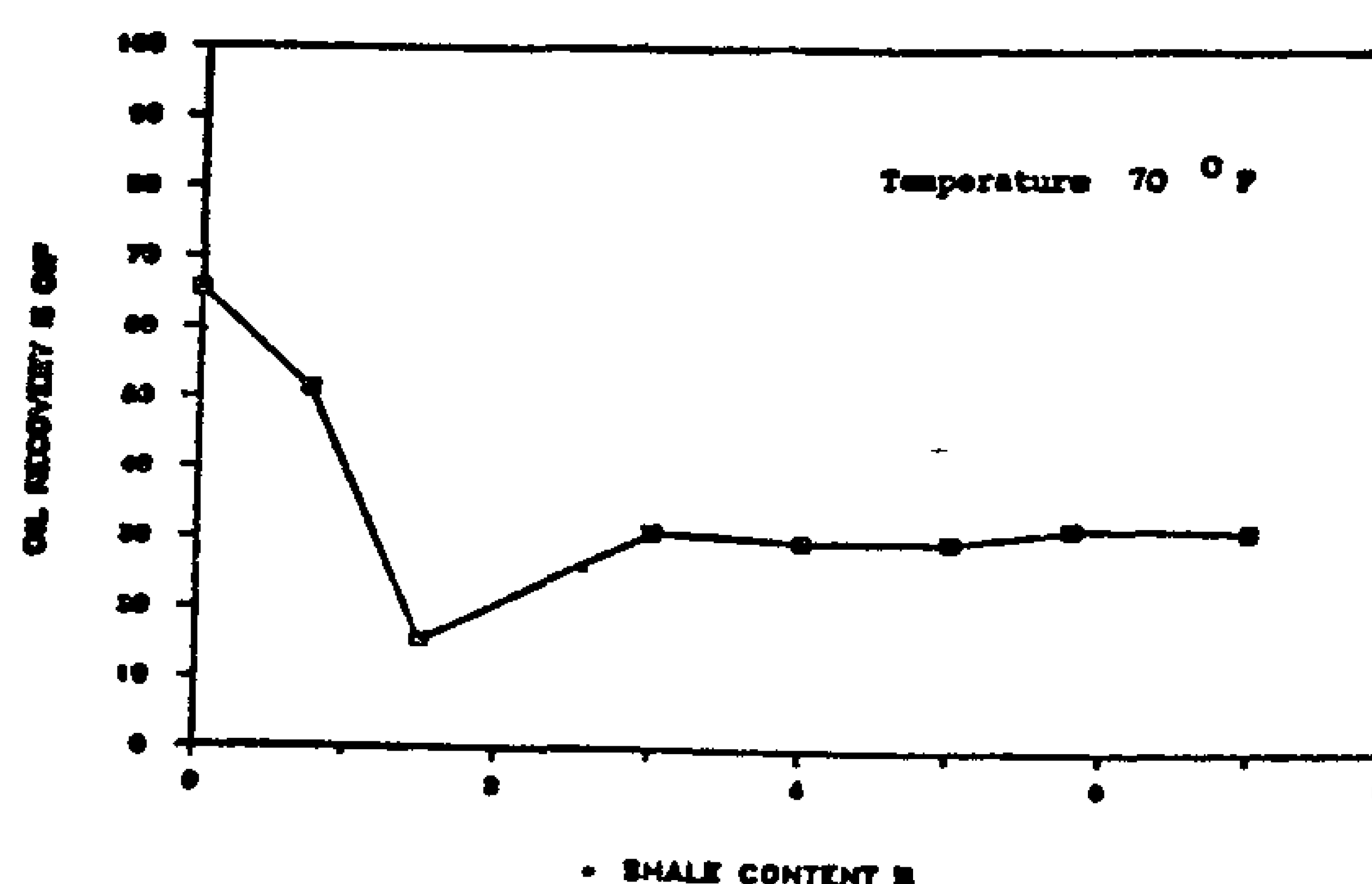


Fig. 5 Effect of shale content on tertiary oil recovery

As outlined previously, the amount of shale content has direct effect on sandpack porosities, connate water saturations permeability, and contact angles. As indicated in the results of both secondary and tertiary recovery processes, the shale content has the same effect on these parameters, and hence on oil recovery. To clarify this, the minimum oil recovery in tertiary recovery process was obtained at 1.5% shale content. At this point a change in permeability and connate water saturation was observed and documented previously in fig. 3. Further, this minimum recovery (at 1.5% shale content) was demonstrated to occur with the maximum contact angle which was obtained at 1.5% shale content.

The direct relationship between Kab and oil recovery is further observed in this figure with the maximum oil recovery obtained at 0.75% shale content which corresponded to having the maximum Kab. Minimum oil recovery occured with the sharp decrease in Kab obtained at 1.5% shale content. Oil recovery exhibited little change as shale content increased above 1.5%.

The porosity of a sandpack as a function of shale content is evaluated next and results obtained are shown also in fig. 3. As shown in this figure, porosity almost the same with different shale contents.

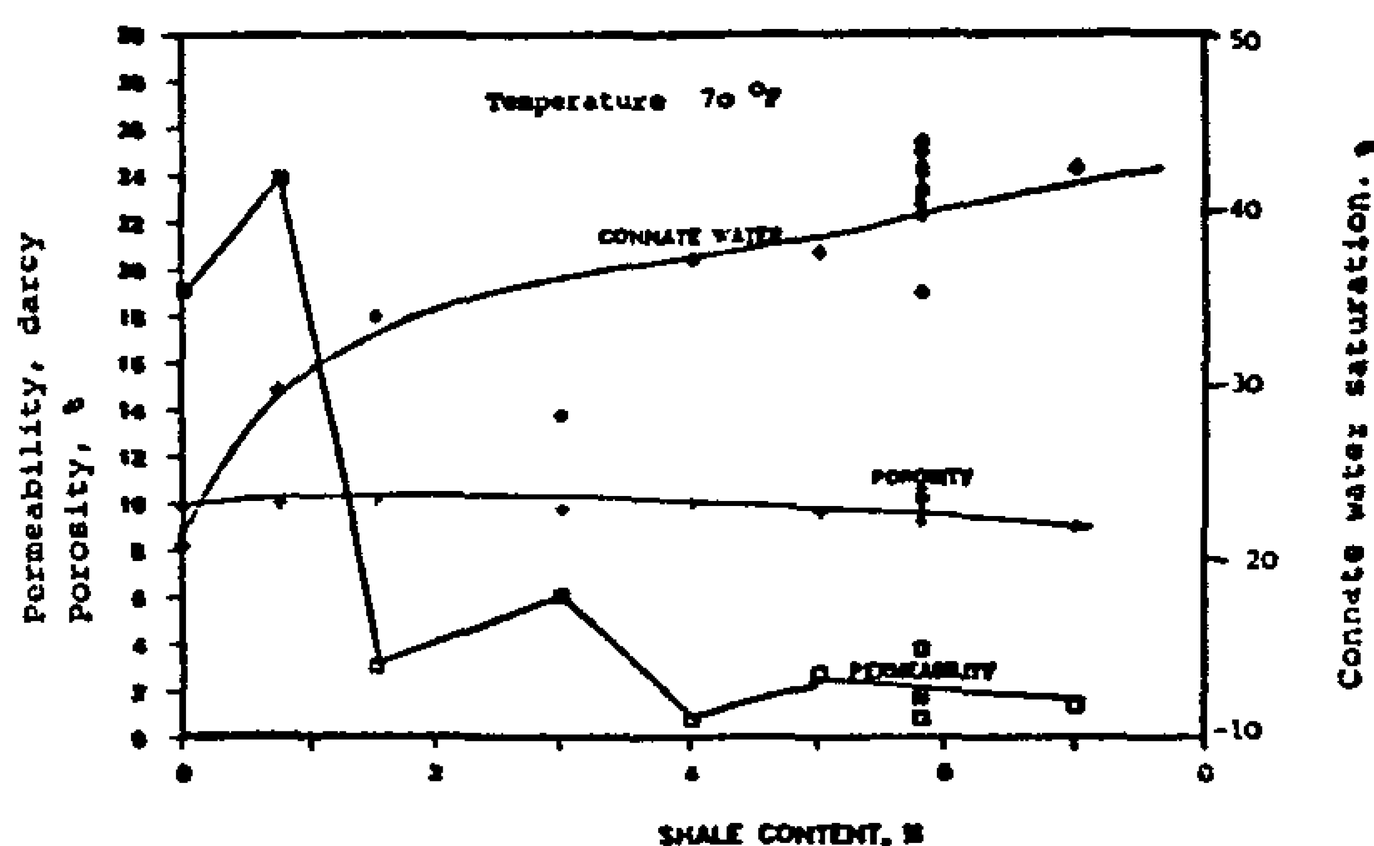


Fig.3 Effect of shale content on absolute permeability, porosity, and connate water saturation.

The effect of shale content on connate water saturation is shown in the same figure. Connate water saturation increases with increasing shale content due to the ability of the shale to attract and hold water. A 21% connate water saturation was obtained at zero shale content. An increase to 34% at 1.5 % shale content is observed. A gradual increase in connate water saturation occured with further increase in shale content above 1.5%. Higher connate water saturation at 1.5% shale content increased the mobility of water which in turn caused an increase in water breakthrough.

Role of Shale Content in Wetting Characteristics:

The wetting phenomena is dirctly related to the surface of the porous medium, and may be expected to vary from point to point on this surface because of the chemical nature of the surface and its physical roughness. The wettability of a core will affect almost all the core properties, including capillary pressure, relative permeability, water flooding behavior, electrical properties and simulated tertiary recovery.

The wettability of an original water-wet reservoir rock can be altered by the adsorption of polar compounds and/or deposition of organic materials originally contained within crude oil on the rock surface (9).

The degree of this alteration can be determined by the interaction of the oil constituents, the mineral surface, and the brine chemistry. In addition to oil composition, the degree to which wettability is altered by the compounds is also determined by the pressure and temperature.

Generally, internal surface of the reservoir rock is composed of many minerals having different surface chemistries and adsorption properties, which may lead to variation in wettability. Several research studies have evaluated the adsorption of polar compounds originally in the crude oil (especially asphaltenes crudes) onto the clays. These studies found in general that adsorption can make the clays more oil wet (7,10-15) Most of this work used dry cores of clays. It is recognized, however that the existence of a water film will generally reduce the adsorption of wettability affecting components. In certain cases, it will completely inhibit the adsorption. (16,17) In the cases of the existence of the multivalent ions C^{++} , and Mg^{++} the wettability would be altered making the system more oil-wet. (18,19)

In this study, the contact angle was measured on the consolidated core surface which is cemented by sodium silicate

mobility control. The polymer in turn was displaced by a brine and production history is determined.

Eight runs were performed at 70°F to determine the effect of shale content on recovery. (0.0, 0.75, 1.5, 3.0, 4.0, 5.0, 5.8, 7.0% shale content were used in these runs respectively). Three runs 9,10,11 were conducted to determine the effect of temperature on oil recovery. These runs were performed at 120, 160 and 200°F, respectively. The temperature was adjusted by injecting thermostated water into core jaket. The effect of slug size was studied in two runs 12,13. The effect of preflush using NaOH or Polymer was studied in runs 14-16.

Shale content 5.8% (actual value of SidkiFormation) was used in runts 9-13.

Contact Angle Measurement:-

Different shale content sand samples were cemented by a solution of sodium Silicate of 0.2 ppm and compared at 800 psi. The sample was left to dry for days. To measure the contact angle, the samples were mounted as shown in the apparatus fig. 2. A droplet of oil was put on sample surface and photographed on slides at a constant period of time. The slides was subsequently projected and the dimension of oil droplets was measured. Then the contact angle was calculated from the equation :

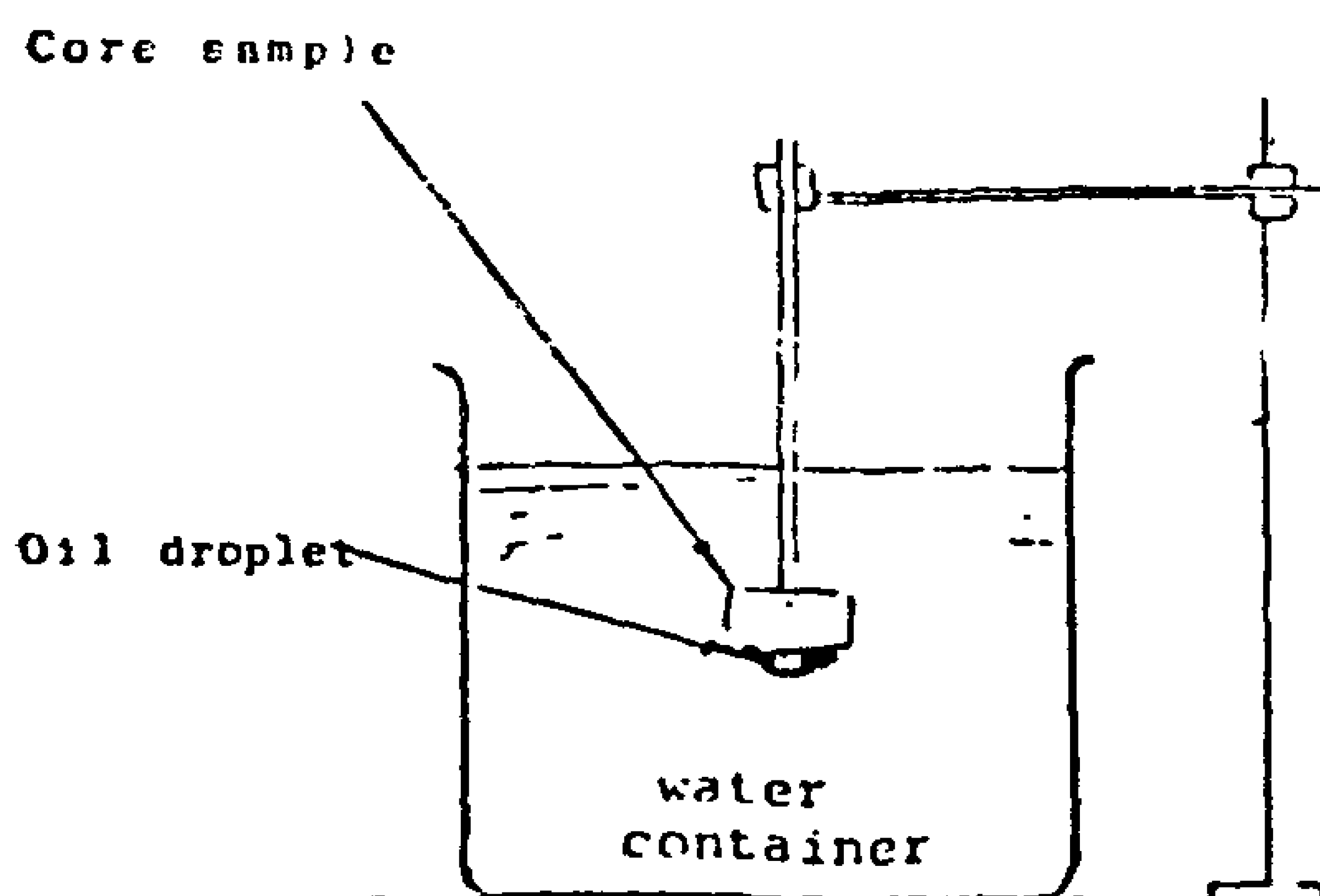


Fig. 2 Contact Angle Apparatus

$$\tan \Theta /2 = d/2h$$

where, d = width
h = height

RESULTS AND DISCUSSION

It is recognized widely that oil producing formations contain a significant amount of clay. Given the large surface area associated with clays and because of the high degree of reactivity of such surfaces, clay can have an important role in the success or failure of any enhanced oil recovery techniques.

Two possible changes can result from the presence of clay within a formation. The first is the hydration of clay which takes place upon an exchange of ions between the minerals within the rock and the flowing liquid. The second is that many clays or clay derivatives act as cementing minerals or are present as a part of rock matrix. These minerals are usually very complex in molecular structure and possess the ability to attract and hold positive ions such as hydrogen, sodium, or calcuim within their structure. Further, these minerals can also demonstrate hydration properties on certain conditions. If volume occupied by these minerals within the porous structure changes then the volume of space available for flow must changes. Thus, the permeability and other rock properties are directly influenced by the clay content.

Effect of Shale Content on The Properties of The Porous Medium:

Fig. 3 shows the effect of shale content on permeability, porosity, and connate water saturation at 70° F. Absolute permeability (Kab) at a 0.0% shale content is equal to 19.5 darcy. An increase in Kab with shale content increases up to the maximum value 23.9 darcy at 0.75% shale content. Then Kab decreases sharply to 3.1 darcy at 1.5% shale content. Above 1.5% shale content a little change in Kab with further increase in shale content.

Table 3 Crude oil analysis

Specific gravity at 60/60°F	(astmd d 1298)	0.8477
API gravity at 60/60°F	(calculated	35.42
Water content by distillation	(astm d 95)	5% volume
Sediment by extraction	(astm d 473)	0.241 % weight
Salt content by analyzer	(astem d 3230)	6.968 p. t. b
Salt content by Tel		2.346 % weight
Reid vapour pressure	(astem d 323)	6.92 psi
Sulfur content	(astem d 1551)	1.44 % weight
Kinamatic viscosity at 100° F	(astem d 445)	4.77 cst
Kinetic viscosity at 100° F	(calculated)	4.04 cp.
Pour poiit	(astem d 97)	35° F
Carbon residue	(astem r 189)	3.5% weight
Paraffin wax	(astem uop 46/64)	2.66% weight
Ash content	(astem d 482/79)	0.49% weight
Asphltenes	(ip 142/57)	0.34

Table 4 Analysis of Connate (Formation) Water

Sodium	62,397 ppm
Calcium	70, 391 ppm
Magnesium	4,256 ppm
Sulfate	233,413 ppm
Cloride	2 ppm
Biocarbonate	24 ppm
TDS	370,000 ppm

Table 5 Analysis of Injection (Sea) Water

Sodium	13,662 ppm
Calcium	701 ppm
Magnesium	1,216 ppm
Chloride	23,4723 ppm
Sulfate	3,164 ppm
Biocarbonate	122 ppm
TDS	47,500 ppm

Table 6 Composition of micellar solution

Surfactant	(Amco 151)	33.25%
Alcohol	(Amco 122)	1.75%
Crude oil	(Sidki crude)	32.5%
Injection	(sea) water	32.5%

Displacement Procedure:-

For each run the linear core was packed throughly with unconsolidated sand containing a certain percentage of bentonite. The packed core was evacuated by a vacuum pump until the pressure inside the core and the connection stabilized at absolute zero for long time. Then the core is saturated with formation water (370,000 ppm, TDS). The porosity of the core is calculated from the volume of water in the core.

The formation water displaced oil until the volume of water in the effluent is practically nil. The connate water saturation Swi and initial oil are calculated from the volume of oil in the core. A brine of 47,500 ppm TDS is injected in the core with a constant pressure. The pressure changed from run to run based on shale content. The effluent is collected in cylinders and production history for secondary process is determined. Then the core is ready for tertiary processing. Slug of micellar is injected into the core followed by a polymer 500 ppm of pusher 500 for a

Therefore it is important to investigate the recovery behavior of a micellar flooding at a varying perceutage of shale content. Hence, the primary objective of this research is to determine the effect of shale content on micellar flooding.

The effect of temperature, and preflush on displacement efficiency using actual value of clay content was also evaluated.

A clear understanding of the effect of formation shale content on tertiary oil recovery by micellar solutions is of value in determining the success or failure of the process in the field.

APPARATUS MATERIALS, AND EXPE RIMENTAL TECHNIQUES

Displacement Apparatus:-

The experimental apparatus is shown in fig. 1. The primary component of the appartus is the unconsolidated core which is a linear core of a dimension of 4.5 cm diameter and 50 cm length. This cylindrical tube was packed with sand having different shale content for each run. A constant air pressure was used to inject fluids from a cylindrical bottels into the core. A vacuum pump with a manometer was used to evacuate the core and the connection prior to any run. An ultra thermostat was used to adjust the core temperature by circulating the thermostated water into the core jackets.

Mechanical Analysis of The Oil Production Formation:-

Oil production formation from Sidki field has been cleaned with dilute solution of HCl (10 % concenteration). Then the sample was dried at 100°F for 6 hours. After that the core became loose or unconsolidated. Then the sample was sieved, and the fractions are shown in Table 1. The composition of shaly sand grains related to shale content is shown in Table 2.

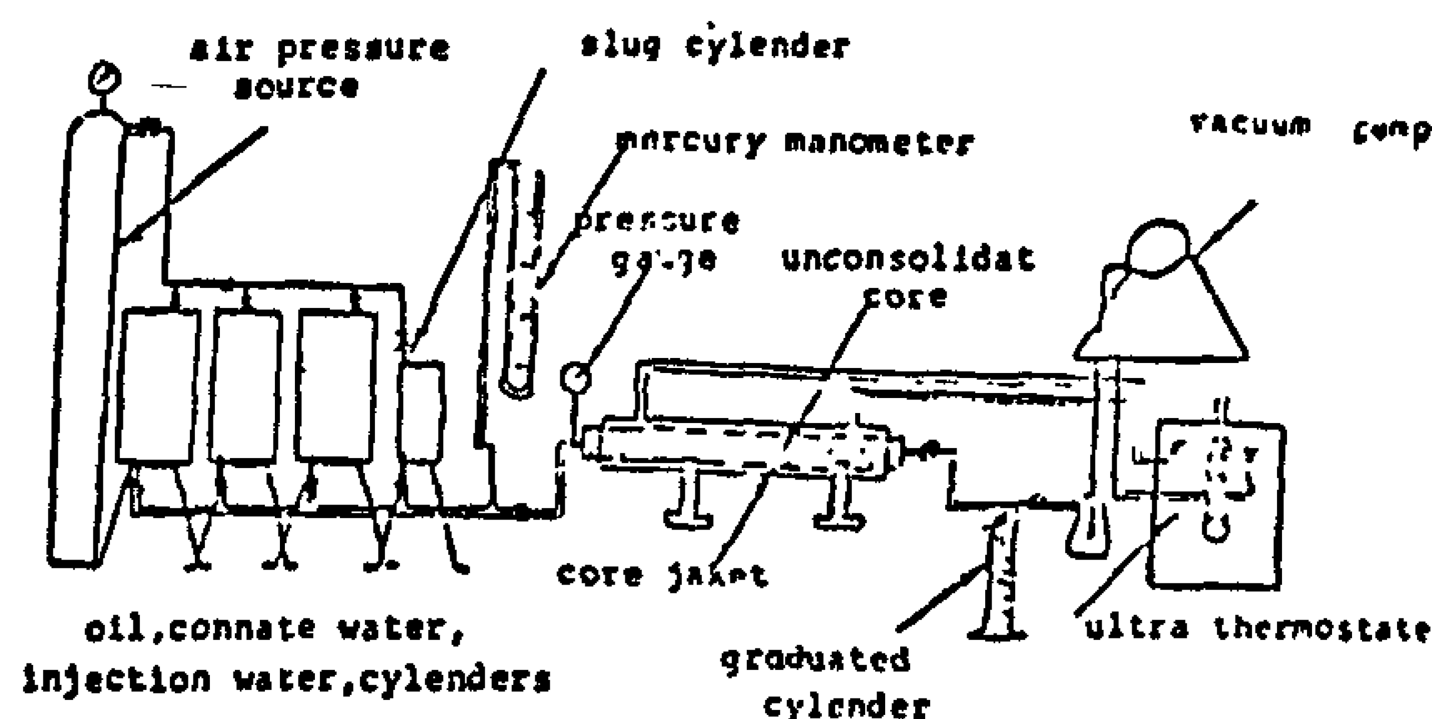


FIG. 1 DISPLACEMENT APPARATUS

Fluid Properties:-

The crude oil used in this work was Sidki crude (obtained from Sidki Field cperated by GUPCO-EGYPT) which has the properties shown in Table 3. The formation water analysis is presented in Table 4. Table 5 shows the analysis of sea water (injection water). The composition of micellar solution used in the research is shown in Table 6.

Table 1 Mecanical analysis of the oil production formation.

Weight (gm)	Weight (%)	Grain size (mm)
181.55	25.4	> 0.495
284.39	39.7	0.351-0.495
151.15	21.1	0.246-0.351
37.15	5.2	0.175-0.246
20.10	2.8	0.104-0.175
41.50	5.8	< 0.104

Table 2 Composition of Shaly sand grains related to shall content Weight

Grain size (mm) \ Shale content (%)	Zero	0.75	1.5	3.0	4.0	5.0	5.8	7.0
> 0.495	26.90	26.70	26.50	26.09	25.82	25.56	25.40	25.02
0.351--0.495	42.20	41.90	41.60	40.93	40.52	40.09	39.70	39.24
0.246--0.351	22.40	22.20	22.05	21.73	21.50	21.28	21.10	20.83
0.175--0.246	5.50	5.47	5.40	5.34	5.28	5.22	5.20	5.12
0.104--0.175	3.00	2.98	2.95	2.91	2.88	2.85	2.80	2.79
< 0.104	0	0.75	1.50	3.00	4.00	5.00	5.80	7.00
Total	100	100	100	100	100	100	100	100

* Actual formation composition

EFFECT OF SHALE CONTENT ON TERTIARY OIL RECOVERY BY MICELLAR FLOODING UNDER EGYPTIAN RESERVOIR CONDITIONS

M. H. Sayyouh*, M. H. Menissi, A. Assal, M. Abu El-dayem

ABSTRACT

The study of tertiary recovery process has grown drametically since the early 1970's. Many processes have been and are being evaluated for their technical and economical feasibility. The utilization of a micellar slug flooding technique has proven to be promising technique for enhanced oil recovery from specific types of reservoirs. This study evaluates the application of a micellar flood to a specific reservoir (Sidki field operated by GUPCO-EGYPT) and further examines the effect of varying shale content within a reservoir on teriary recovery process.

Shale content is a major factor in overall recovery efficiency within a reservoir due to the large surface area and highly reactive ionic characteristics of the clay particles. As demonstrated in this study. tertiary recovery are decreased sharply as shale content increases to 1.5 %. A small increase in recovery obtained as shale content increases from 1 5% to 3.0%, and changes little with shale content increases above this value.

For the specific Sidki resrevoir containing 5.8% shale content, it was determined that the net oil recovery of 16.6% OIP could be achieved using a 12% pv of micellar slug. It was found also that tertiary oil recovery by micellar slugs increased with an increase in temperature up to 120°F. Thereafter, it showed a small decrease with further increase in temperature. Using NaOH and polymer preflush prior to tertiary oil recovery did not improve displacement efficiency.

INTRODUCTION

Reservoir engineering research in the past three decades has been primarily concerned with the economic recovery of additional oil from the existing reservoirs. This has entailed, among after things, investigations that resulted in a better understanding of multiphase fluid flow in porous media, the discovery of new oil recovery techniques, and experimentations showing the role of various parameters that control operating recovery mechanisms.

Displacement of oil by micellar solutions is an important process, proposed, described ,and analysed in references (1-3) Field testing of this type of oil recovery process has established it as technically and economically feasible enhanced oil recovery technique . The micellar solutions are composed of hydrocarbons, water a surfactant, and a co-surfactant Micellar displacement involves sequential injection of micellar slug, a mobility buffer, and drive fluid.

Among the factors that play an important role in micellar flooding is the shale content. Many oil producing formations contain significant amount of clay. Because of the large surface area of clays and because of the high degree of reactivity of such surfaces, clays may play an important role in the success or failure of micellar flooding[7].

* Now witw King Saud University.

overvoltage on P_bO (α) and P_bO (β) in 4.4 N H_2SO_2 yields 0.2 and 0.6 volts respectively, [11]. G.W. Warren et al. [12], proposed the oxygen reduction on $CuFeS_2$ as a possible account for the current peak at 0.2 volts in 1 M H_2SO_4. That is an overpotential of about 1.0 volt is needed for oxygen reduction on cholcopyrite.

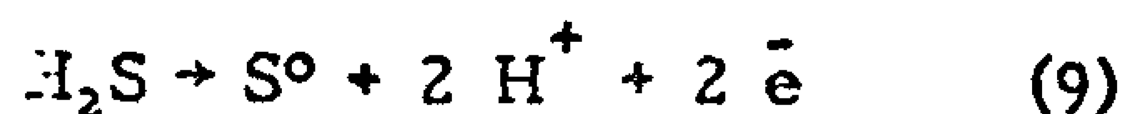
The reduction of oxygen on sphalerite would need a cathodic overvoltage represented by the path $\vec{I_4}$ in Fig. (4). The valaue of overvoltage (η) is expected to be in the range of 0.7 to 0.9 volts according to the specific surface properties of the mineral.

Path $\vec{I_3}$ corresponds to the reaction (3). At P_3, the cathodic reaction is:



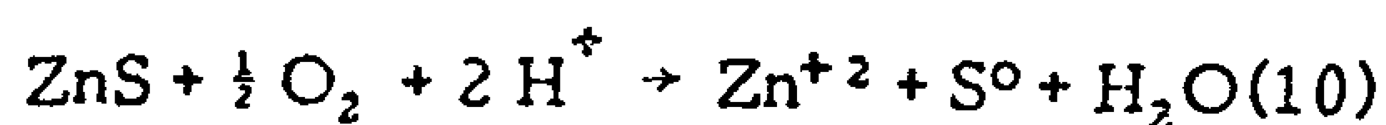
$$ZnS \rightarrow Zn^{+2} + S^o + 2\bar{e} \qquad (8)$$

and also the following anodic reaction accounts :



$$H_2S \rightarrow S^o + 2H^+ + 2\bar{e} \qquad (9)$$

The net leaching reaction, from (3), (8), and (9) is :



$$ZnS + \tfrac{1}{2}O_2 + 2H^+ \rightarrow Zn^{+2} + S^o + H_2O \qquad (10)$$

5. Conclusion :

Leaching of ZnS by H_2SO_4 can be interpreted in terms of E-pH diagrams to define the final products when the conditions of the system are fixed. Reactions can be represented as vectors leading to the final state.

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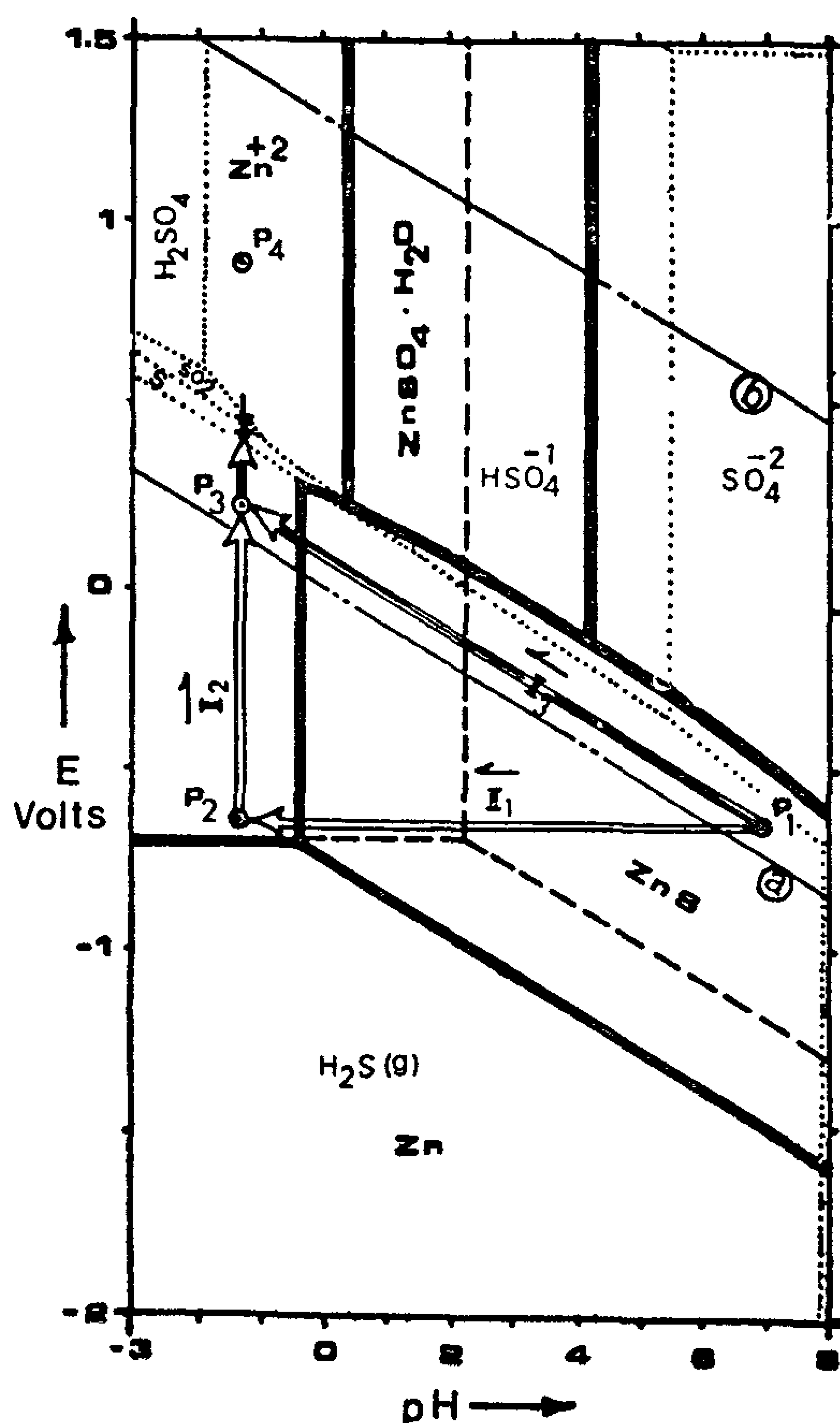
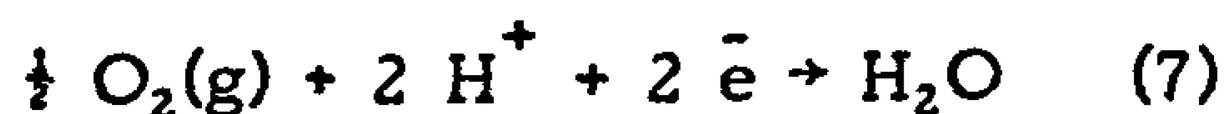


Fig. (3) : E - pH Equilibrium Diagram for Zn - S - H_2O System at T = 250 C, P= 1 atm. Vectors show Leaching Path of ZnS in Conc. H_2SO_4 at pH = - 0.6,

The cathodic oxygen reduction under these conditions is :



$$\tfrac{1}{2}\, O_2(g) + 2\, H^+ + 2\, \bar{e} \rightarrow H_2O \qquad (7)$$

ΔF° (150°C) = -51,943.78 Cal.,

and hence;

E° = 1.125 volts.

Then the value of E at the above pH and oxygen pressure is :

$$E = 1.125 + 0.0837\, pH + 0.0837 \log (PO_2)^{\frac{1}{4}} = 1.13 \text{ volts.}$$

This value is represented as point P_4 in Fig. (4).

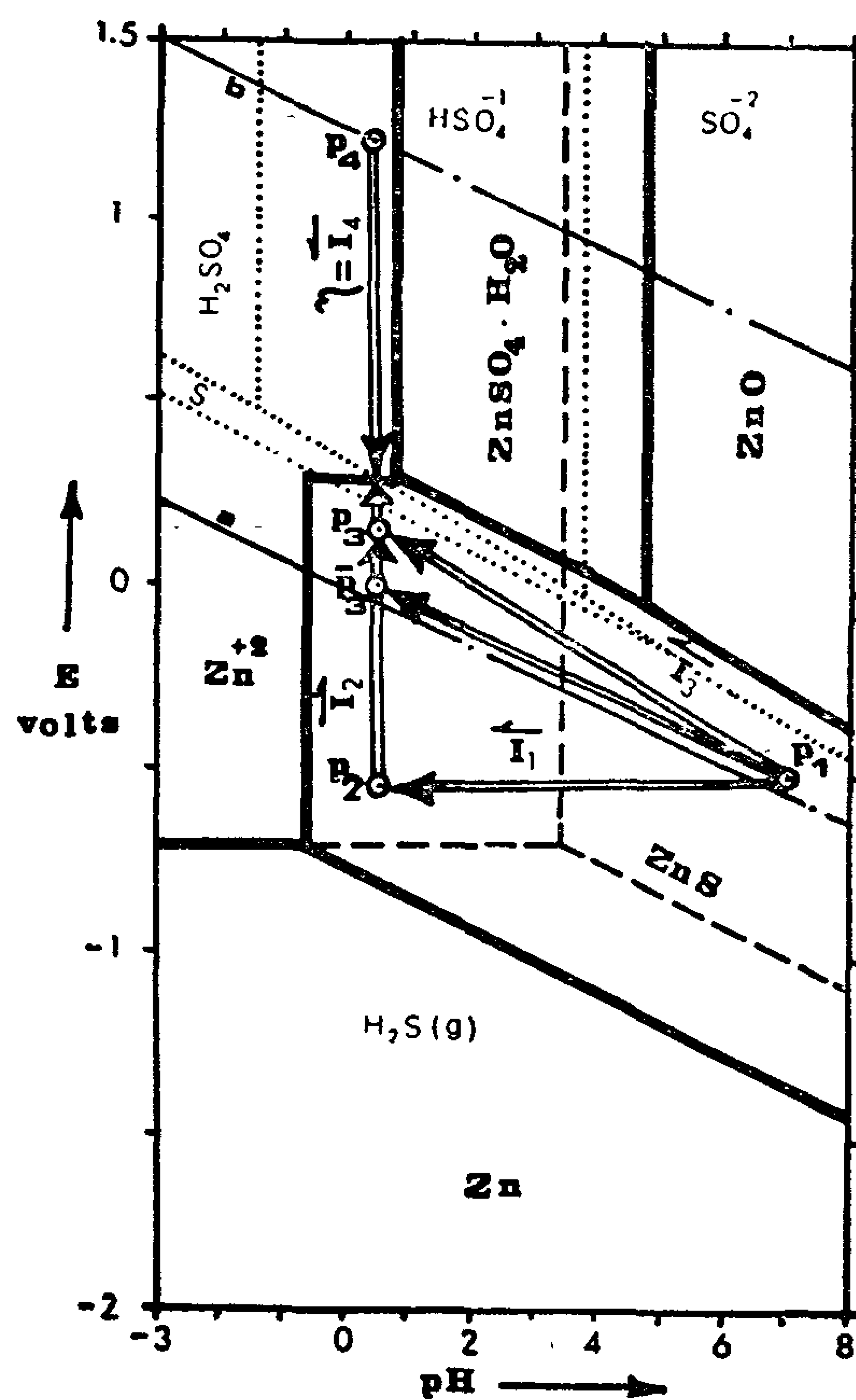


Fig. (4) : E - pH Equilibrium for Zn - S - H_2O System at T = 150 C. Vectors show Oxygen Pressure Leaching Path of ZnS in H_2SO_4 at pH = + 0.3, Oxygen Partial Pressure = 7.402 atm.

The ZnS specimen at 150°C and pH = 7.0, point P_1 is subjected to the leaching conditions represented by P_4, Fig. (5). $\overrightarrow{I_1}$ path, due to pH change forms Zn^{+2}, $H_2S(g)$ both less than 1 mol./l. The negligible percentage of $H_2(g)$ in the atmosphere is expected to affect the path $\overrightarrow{I_2}$ to be larger than normal atmosphere due to the lower partial pressure of $H_2(g)$. Thus, point $\overline{P}_3$ results instead of P_3. A cell forms from the cathodic potential P_4 and the anodic potential P_3. As discussed before, point P_3 would move to approach point P_4. In this specific case, the reduction of oxygen does not occur without an overvoltage especially on a mineral surface. The measurement of oxygen

point P_I. Upon the addition of concentrated H_2SO_4 the pH decreases to - 0.6. Assume that the pH is kept constant at this value. The path $\overrightarrow{I_1}$, Fig. (2), represents the increase of H^+ ions in the solution. However, the stability of H_2O, under the same conditions of $H_2(g)$ pressure, assumes the path $\overrightarrow{I_3}$ to be followed to reach point P_3. Thus, the H_2O stability produces the $\overrightarrow{I_2}$ path superimposed on $\overrightarrow{I_1}$.

Concentrated H_2SO_4 at 300°C is stable above 0.6 volts. Thus, a point, P_4 at pH = -0.6 would represent on anodic relative to point P_3.

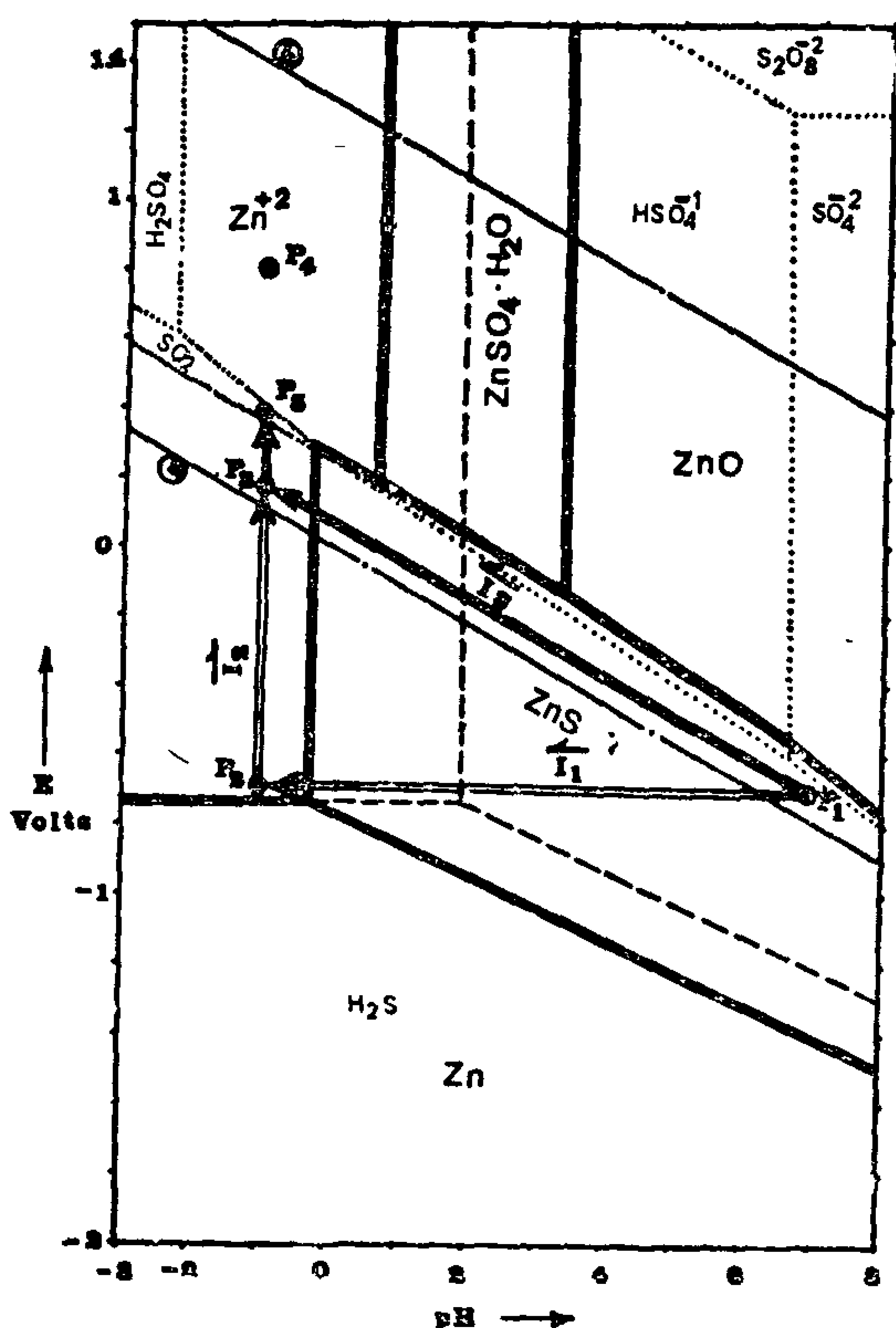


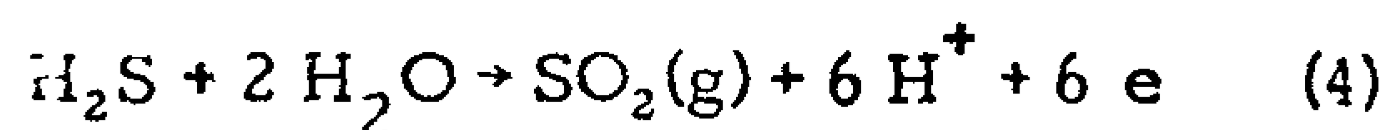
Fig. (2) : E-pH Equilibrium Diagram for Zn - S - H_2O System at T = 300 C, atm. Vectors show Leaching Path of ZnS in Conc. H_2SO_4 at pH = - 0.6

Path $\overrightarrow{I_3}$, may be represented by the reaction:



$$ZnS + 2\,H^+ \rightarrow Zn^{+2} + H_2S \qquad (3)$$

Point P_3 is cathodic to point P_4. The cell formed due to the potential difference P_4 - P_3 would cause the shift of point P_3 upwards to approach P_4. This is assumed on basis of excess H_2SO_4. The tendency of P_3 to move up can be represented by the anodic reaction:



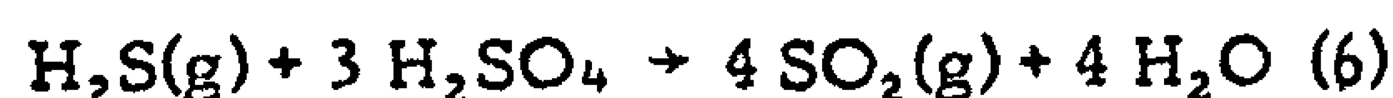
$$H_2S + 2\,H_2O \rightarrow SO_2(g) + 6\,H^+ + 6\,e \qquad (4)$$

The cathodic reaction at P_4 can be represented by the following reaction :



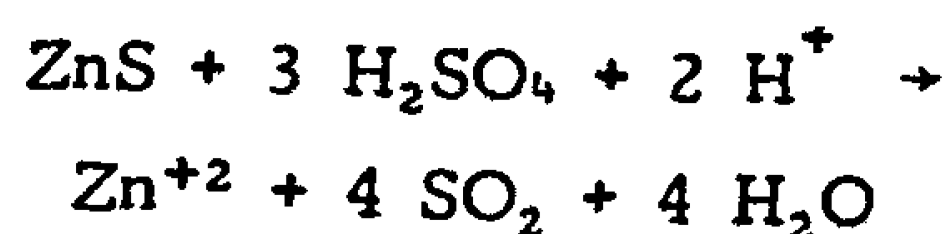
$$3\,H_2SO_4 + 6\,H^+ + 6\,\bar{e} \rightarrow 3\,SO_2 + 6\,H_2O \quad (5)$$

The net reaction of the cell (P_4 - P_3) is the summation of reactions (4) and (5) as follows:



$$H_2S(g) + 3\,H_2SO_4 \rightarrow 4\,SO_2(g) + 4\,H_2O \quad (6)$$

Adding reaction (3) to reaction (6) yields the leaching reaction :



$$ZnS + 3\,H_2SO_4 + 2\,H^+ \rightarrow Zn^{+2} + 4\,SO_2 + 4\,H_2O$$

which is :



$$ZnS + 4\,H_2SO_4 \rightarrow ZnSO_4 + 4\,SO_2 + 4\,H_2O$$

When the temperature is decreased to 250°C, the S-H_2O diagram, reported before, (1), would yield Fig. (3), which shows the formation of both SO_2(g) and S°.

5. Oxygen Pressure Leaching

Concentrated H_2SO_4 at 150 gm/1, may be considered to correspond to pH = + 0.3, based on activity coefficient 0.15 [11] at molality of about 1.53 mole/1. Taking the atmospheric pressure as 101.32 Kpa [12], the partial pressures of the leaching process associated with reaction (IV) are :

Species:	O_2	H_2O(v)	Inerts	Total
P(atm):	7.402	4.737	0.691	12.83 atm,

potential should lie in the stable regions of both the mineral and H_2O. Since, the minute chemical conversions of all the competing species are incontrollable the rest potential would be unstable. In other words, the rest potential, in such cases, becomes a sensitive 'mixed potential'.

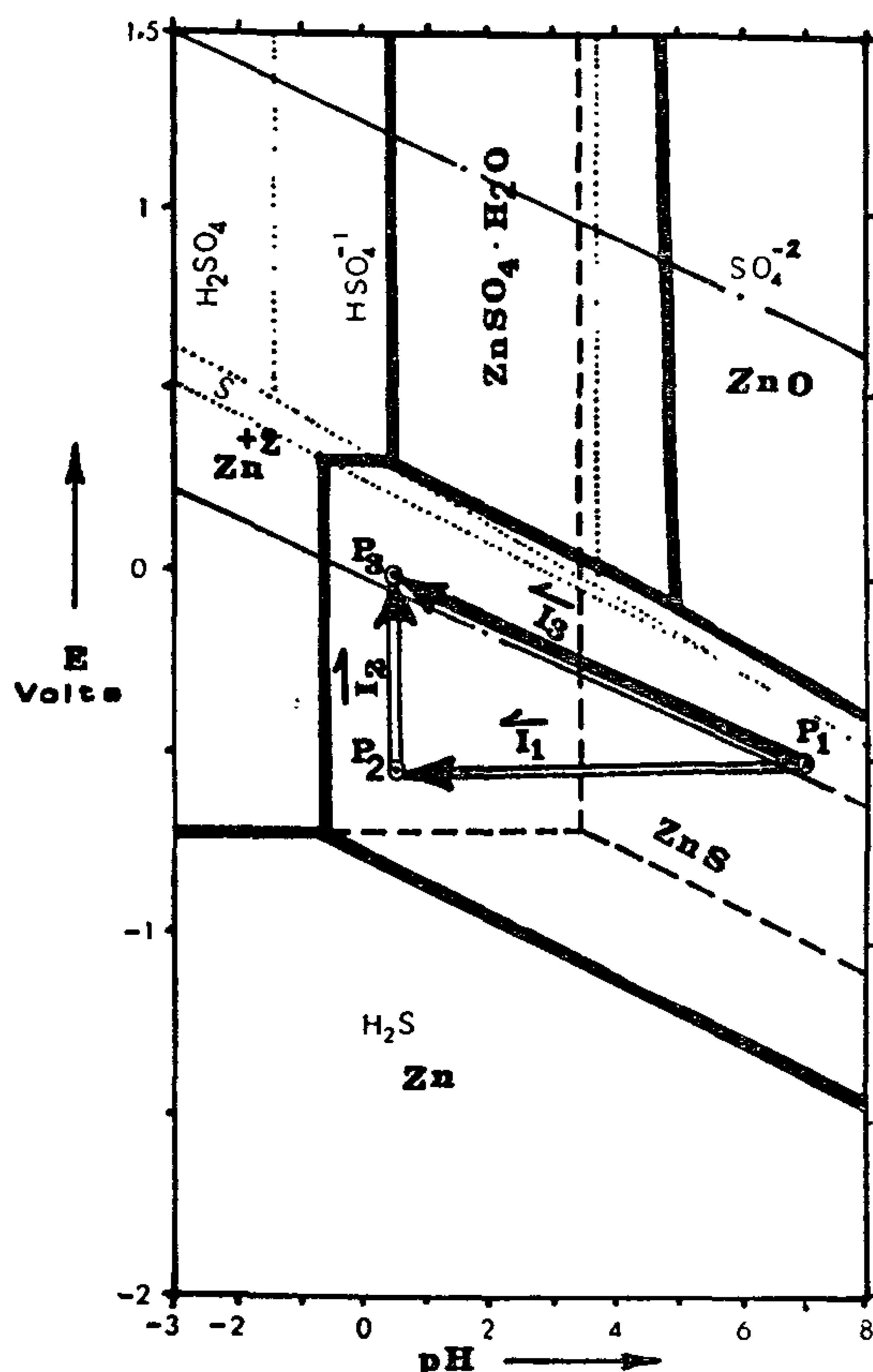
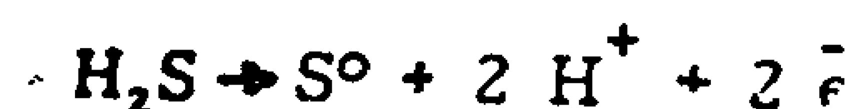


Fig. (1) : E - pH Equilibrium Diagram for Zn - S - H_2O System at T = 150 C. Vectors show Leaching Path of ZnS in Dilute H_2SO_4 at pH = + 0.7.

Point P_1 represents the rest start point of ZnS at pH = 7.0. The addition of H_2SO_4 up to pH = +0.6 would correspond to path ($\vec{I_1}$), Fig. (1). That is P_1 moves to P_2. At such value, Zn^{+2} forms up to 0.0177 mol./l, (about 2 x 10^{-2} M.). Simultaneously, $H_2S(g)$ liberates. If the pH is kept constant at 0.6, the system would have, one degree of freedom along the line pH = 0.6. The solubility of $H_2S(g)$ in the solution restricts the freedom of the system. For 0.1 M solubility at 1 atm, the system becomes saturated with $H_2S(g)$ at point P_2. That is the system has to move into a value of $[H_2S(g)]$ = 0.1 M. on the S-H_2O diagram. The intersection of the line pH = 0.6 with the 0.1 M. contour of $H_2S(g)$ leads to point P_3. The stability of $H_2S(g)$ in S-H_2O system can be represented by the reaction:



$$H_2S \rightarrow S^o + 2\ H^+ + 2\ e^-$$

at 150 °C, and the equilibrium Nernst relation is :

$$E = 0.252 - 0.059\ pH$$
$$- 0.059\ Log\ [pH_2S(g)] \qquad (2)$$

Relation (2) is shown in Fig. (1) as dashed line.

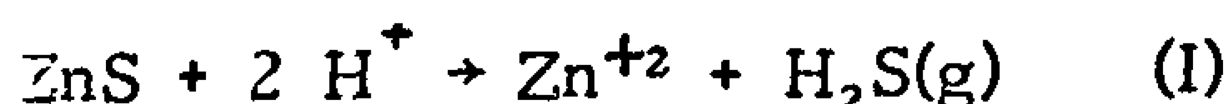
The vector addition of $\vec{I_1}$ and $\vec{I_2}$ leads to the net path $(\vec{I_3})$. Thus when ZnS at pH = 7 is treated by H_2SO_4 that keeps the pH of the system at 0.6, the system follows the path P_1 - P_3. This explains the oxidizing nature of H_2SO_4, in terms of increasing the potential to anodic values through the vector $\vec{I_2}$. That is, the formation of the gaseous product H_2S causes the increase of the potential. $H_2S(g)$ liberates, leaving the reacting system providing more free energy driving force for the reaction by virtue of the Goldberg Waage law of mass action.

4. Concentrated Acid Leaching :

The effect of concentrated H_2SO_4 on ZnS can be interpreted on bases of electrochemical equilibrium diagrams. H_2SO_4 at 93% concentration corresponds to pH = -0.6.

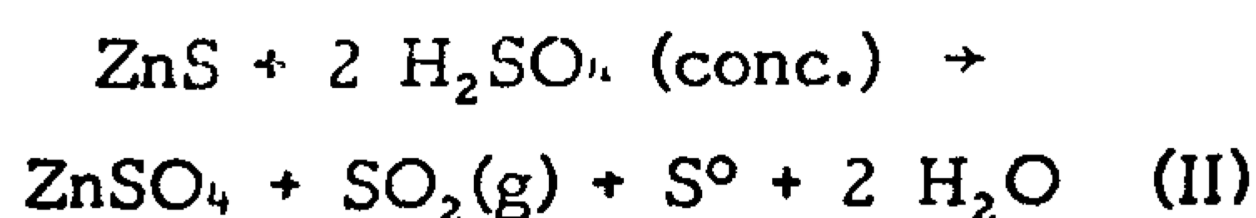
The case of High temperature is shown in Fig. (2) at 300°C. The details of the S-H_2O diagram below pH = 0.0 were reported before [4]. Consider a ZnS specimen placed in pure H_2O at pH = 7.0. Let H_2 pressure is such that the potential can be represented at

Pawlek and Pietch [4], studied the effect of 10% H_2SO_4 at 120°C on sulfides. A.I. Golomzik [5] leached Cu-Zn sulfide mixture in dilute H_2SO_4 at 155°C-170°C. $H_2S(g)$ is formed according to the reaction :



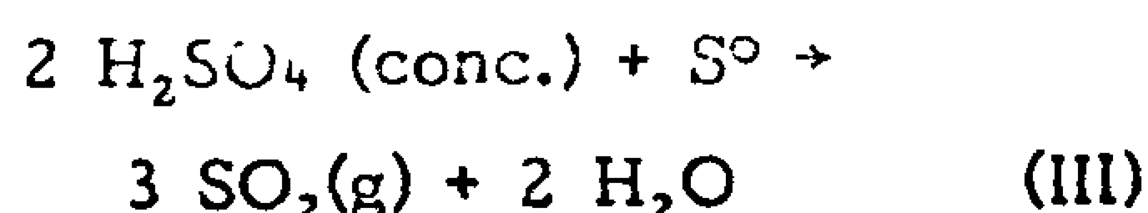
$$ZnS + 2\,H^{+} \rightarrow Zn^{+2} + H_2S(g) \qquad (I)$$

The concentrated H_2SO_4 at about 93% concentration dissolves Zn, Cu, and Fe from the polysulfide ore [6]. The reaction produces $SO_2(g)$ instead of $H_2S(g)$ with the dilute acid. For ZnS, the reaction is represented as:



$$ZnS + 2\,H_2SO_4\,(conc.) \rightarrow$$
$$ZnSO_4 + SO_2(g) + S^{o} + 2\,H_2O \qquad (II)$$

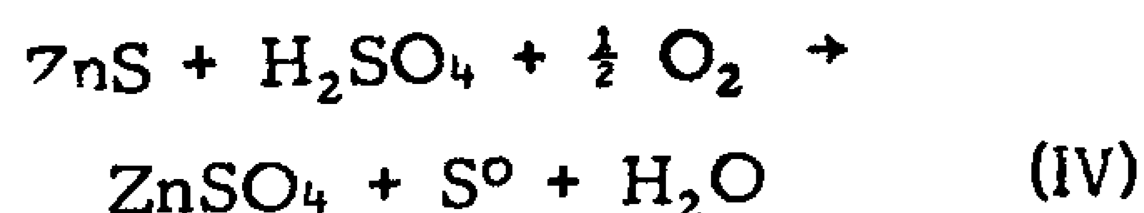
At high temperature, sulfur is converted into SO_2 (g) aacording to the following reaction:



$$2\,H_2SO_4\,(conc.) + S^{o} \rightarrow$$
$$3\,SO_2(g) + 2\,H_2O \qquad (III)$$

The pressure leaching of ZnS in H_2SO^4 under oxygen pressure at elevated temperatures was originated by F.A. Forward and H. Veltman (7). Pressure leaching of ZnS has the advantage of excluding the roasting process prior to lypical acid leaching. Thus, capital cost is lowered. Also, elemental sulfur is produced rather than SO_2 (g),which causes air pollution. Sulfur is considered as a product, while SO_2 production needs the leaching plant to be closely tied to acid or fertilizer production.

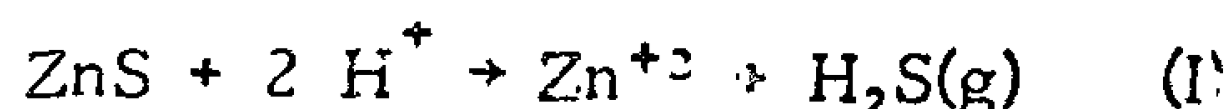
G.E. Parker et al. (8,9) constructed a pilot plant to leach 3 tons per day of Cominco's Sullivan zinc concentrate at 150°C Spent electrolyte containing 150 gm/L of $H_2\,SO_4$ is added into the first of four outoclaves. The outoclave operates under a total pressure of 1300 Kpa consisting of about 750 Kpa oxygen, 480 Kpa vapour and 70 Kpa inerts. The process produces a zinc sulphate solution and elemental sulfur. The overall reaction is :



$$ZnS + H_2SO_4 + \tfrac{1}{2}\,O_2 \rightarrow$$
$$ZnSO_4 + S^{o} + H_2O \qquad (IV)$$

Dilute Acid Leaching :

Dilute 10% H_2SO_4 corresponds to about pH = +0.6 [10]. At such value and 120°C, Zn^{+2} ion and $H_2S(g)$ would form. Reaction (I) is simply the replacement of the weak acid, H_2S from its salt, Zns, by the strong acid H_2SO_4:



$$ZnS + 2\,H^{+} \rightarrow Zn^{+2} + H_2S(g) \qquad (I)$$

The free energy change of reaction (I), at 150°C is : $G^{o} = 3003.48$ cal.
This value leads to:

$$-3.5734 = Ln\,\frac{[Zn^{+2}]\,[p(H_2S)]}{[H+]^2} \qquad (1)$$

If the chemical balance is applied such that, the only source of the sulfur species, H_2S (g), is ZnS; then the activities of both Zn^{+2} and H_2S are equal and the value is :

$$-1.552 = \log\,[Zn^{+2}] + Log\,[p(H_2S)] + 2\,pH \qquad (2)$$

Applying pH = +0.6, then :

$$[Zn^{+2}] = 0.04\ mol./l$$

It should be noted that the solubility of $H_2S(g)$ at 1 atm. is 0.1 M. Applying this value in relation (2), the activity of Zn^{+2} becomes:

$$[Zn^{+2}] = 0.0177\ mol./l$$

The representation of dilute acid effect on ZnS on the electrochemical equilibrium diagram at 150°C is shown in Fig. (1). Let a specimen of ZnS be stirred in pure H_2O at pH = 7.0, and at T = 150°C. If the dissolved $H_2(g)$ is such that, the potential of H_2/H^{+} electrochemical conversion corresponds to point P_I, then, the inert ZnS surface would exhibit the potential P_I . In fact, the rest potential of a mineral in pure water is not stable. Such

INTERPRETATION OF ACID LEACHING REACTIONS OF ZnS ON BASES OF E_H-pH DIAGRAMS

M.F. El-Demerdash *

ABSTRACT

The different sulfur species produced during ZnS leaching by H_2SO_4 at different conditions are analysed on bases of E-pH diagrams. A sort of correlation between the initial conditions and the final products is deduced.

I. Introduction

It has been the aim of inorganic chemistry to represent the substance quality in terms of quantity. Since Dobreiner triads and Newland octavs, the periodic nature of elements properties reached a periodic table in Mendeleev's work and in the modern periodic table. The chemical reactions between compounds, also, found exact rules, especially, in the acid-base reactions. However, in other cases reactions are still known as experimental facts. Among these are sulfur compounds reactions.

Under certain conditions, H_2S (g) forms, or SO_2 (g) or elemental sulfur or both SO_2 and S. The initial conditions of H_2SO_4 reacting with ZnS, does not provide the theoretical bases that specify whether H_2S, SO_2, S, or both S and SO_2 would form. It is the aim of this work to find out quantitative theoretical bases that provide a unique reaction products in terms of the thermodynamic properties under the reaction conditions.

Electrochemical equilibrium diagrams as a graphic summary of aqueous chemistry provides a tool of the above aim. The activity - term method [1-3] is published before as a simple routine of drawing the diagram at high resolution. In the S-H_2O system at high temperature, the method resolved the zones of stability of SO_2(g). In addition, S and H_2S(g) are present, both at room temperature and at elevated temperatures.

It is the view of the author, to represent chemical conversions in aqueous solutions as vector paths on E_H-pH diagrams. These vectors are defined from the initial conditions of the reaction and from the concept of electrochemical cell representation in aqueous reactions. The net reaction is splitted out as two electrochemical reactions. Any reaction reaches completion when the anodic and cathodic potentials approach the same value. That is, the cell potential is zero, and an equilibrium state is attained. Thus, the points representing E_A «Anodic Potential», and E_C «Cathodic Potential» move towards each other. If the reaction conditions are fixed, the movement of E_C or E_A are constrained to satisfy such fixed conditions. The net approach of E_C and E_A defines the zones of final products.

This analysis is applied to the acid leaching of Zns as practiced both in the lab and the industrial scale.

2. Acid Leaching of Sphalerite, Zns

The acid leaching of ZnS, considered here, is divided into three cases, the dilute acid leaching, the concentrated acid leaching, and the oxygen pressure leaching.

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3 — Comparison of the calculated polythermal sections with the experimental results yields good agreement lies within the range ± 3°C

AKNOWLEDGEMENT:

The auther wishes to thank Prof. Dr. M. Selim, The Rector of El-Tabbin Institute for Metallurgical Studies and Mr. Atif El-Sabby for giving all facilities during conducting the experimental part of this work.

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Table (4): Results of experimental critical temperatures of alloys of systems Al - Cu - Fe and Al - Cu - Mn.

System	Composition wt.%		Results of DTA, °C					
	Cu	Fe	1*	2*	3*	4*		
Al-Cu-Fe	0.99	1.00	656.5	—	651.0	646.0		
	2.22	0.26	652.0	—	642.0	638.0		
	3.01	1.10	648.5	—	643.0	635.5		
	5.52	0.48	645.5	—	622.5	595.5		
	8.84	0.85	635.0	—	616.0	603.0		
	2.61	2.84	679.5	—	653.0	639.5		
	4.02	2.75	652.0	—	643.5	627.5		
	5.00	2.10	673.0	—	641.0	603.5		
	9.31	1.86	646.0	—	625.0	588.0		
	9.61	2.78	683.0	—	628.0	589.0		
	Cu	Mn	1*	2*	3*	4*	5*	6*
Al-Cu-Mn	1.01	1.45	657.0	—	633.0	612.0	—	—
	2.02	0.62	651.5	613.0	—	—	—	—
	8.51	0.58	633.5	—	—	—	672.0	630.0
	0.82	3.31	695.0	—	702.0	704.0	653.5	625.0
	5.31	2.20	652.5	—	622.0	617.0	593.0	578.0
	9.80	1.88	635.5	—	635.0	627.0	622.5	616.0
	0.51	4.51	720.0	—	708.0	701.0	656.0	631.0
	1.98	4.48	721.5	—	696.0	680.0	633.5	622.5
	7.22	4.62	725.0	—	640.0	636.5	628.0	618.0
	8.30	3.87	690.0	—	637.5	635.5	632.0	631.0

* See table (3)

This establishes the validity of thermodynamic calculations of the studied systems and permits calculation of any polythermal sections without the need for experimental confirmations.

CONCLUSIONS:

1 — The chemical potential function of Al, Cu, Mn and Fe for the three equilibrium regions : $L \rightleftharpoons \alpha_{Al}$, $L \rightleftharpoons MnAl_4$, $L \rightleftharpoons MnAl_6$ in Al - Cu - Mn system as well as for the two equilibrium regions $L \rightleftharpoons \alpha_{Al}$, $L \rightleftharpoons FeAl_3$ in Al - Cu - Fe system are determined.

2 — The obtained chemical function expressions are used for calculating the liquidus and solidus surfaces as well as polythermal sections of aluminum rich side of both systems.

Table (3): Thermodynamic calculation critical temperatures for Al - Cu - Fe and Al - Cu - Mn alloys.

system	Composition wt.%		Calculated critical temperature, °C					
	Cu	Fe	1*	2*	3*	4*		
Al-Cu-Fe	0.99	1.00	655.0	---	653.0	647.0		
	2.22	0.26	652.5	---	640.0	635.0		
	3.01	1.10	648.5	---	644.0	635.0		
	5.52	0.48	643.0	---	620.0	595.0		
	8.84	0.85	632.5	---	619.0	600.0		
	2.61	2.84	682.0	---	650.0	640.0		
	4.02	2.75	655.5	---	642.0	628.0		
	5.00	2.10	670.5	---	638.0	601.0		
	9.31	1.86	644.5	---	628.0	591.0		
	9.61	2.78	686.5	---	625.0	587.0		
	Cu	Mn	1*	2*	3*	4*	5*	6*
Al-Cu-Mn	1.01	1.45	655.0	---	630.0	610.0	---	---
	2.02	0.62	653.5	612.0	---	---	---	---
	8.51	0.58	636.5	---	---	---	640.0	632.0
	0.82	3.31	683.0	---	705.0	702.0	651.0	622.0
	5.31	2.20	650.5	---	620.0	616.0	590.0	576.0
	9.80	1.88	637.5	---	633.0	629.0	620.0	615.0
	0.51	4.51	74.0	---	705.0	703.0	652.5	633.0
	1.98	4.48	720.5	---	693.0	687.0	636.0	620.5
	7.22	4.62	723.0	---	638.0	634.0	626.0	620.0
	8.30	3.87	692.0	---	640.5	638.0	635.0	629.0

* 1. Liquidus temperature,

2. The end of solidifation of α - solid solution,

3. The begging of solidifation of binary eutictic L + α + $FeAl_3$ in Al-Cu-Fe system or L+ $MnAl_4$ + $MnAl_6$ in Al-Cu-Mn system,

4. The end of solifation of binary eutictic L + α + $FeAl_3$ in Al-Cu-Fe system or L + $MnAl_4$ + $MnAl_6$ in Al-Cu- Mn system,

5. The begging of solidifation of binary eutictic L + α + $MnAl_6$ in Al-Cu-Mn system.

6. The end of solidifation of binary eutictic L + α + $MnAl_9$ in Al-Cu-Mn system.

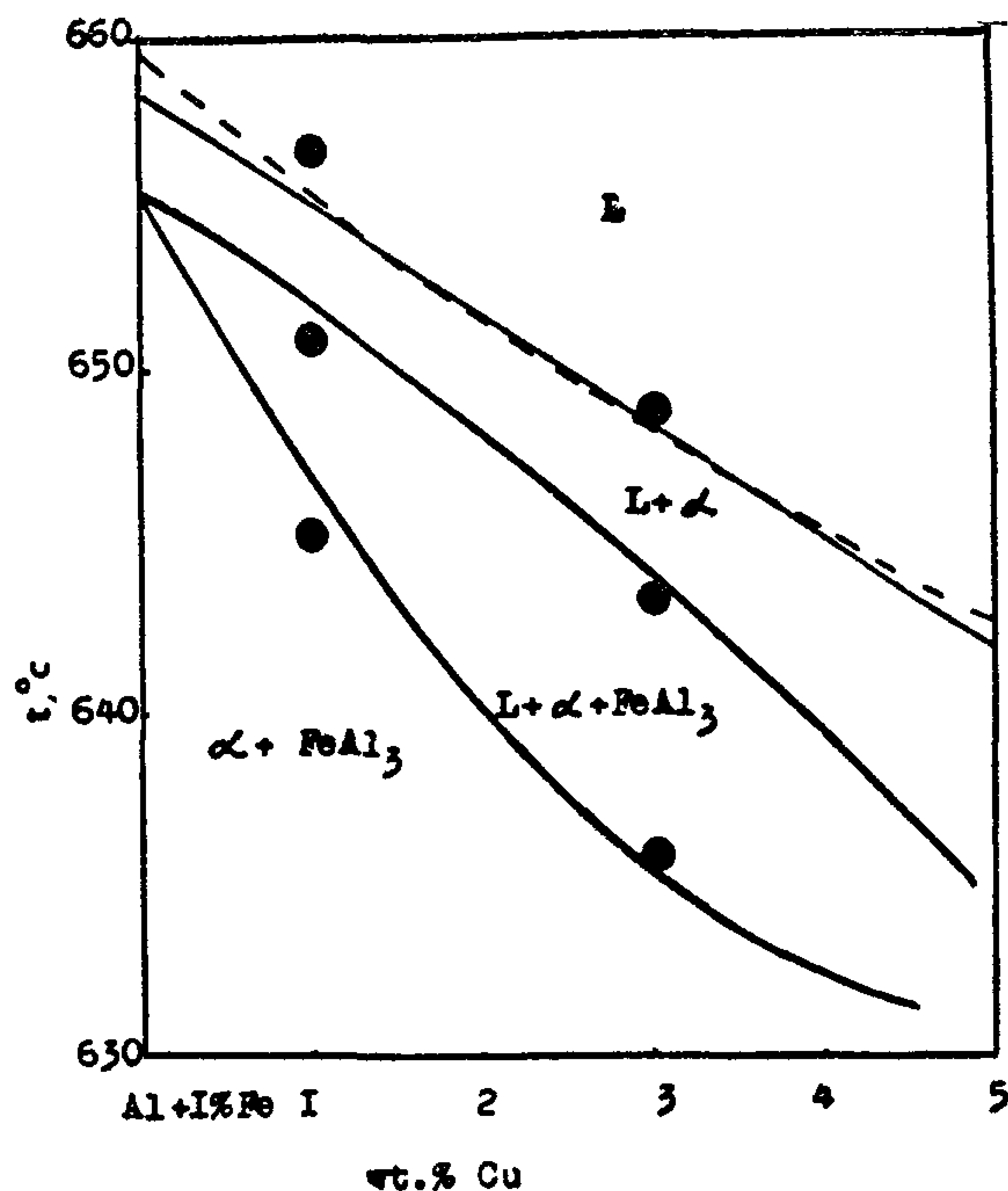


Fig. 6 Vertical section at constant 1% iron of the system Al-Cu-Fe.
— - Results of calculations,
● - Results of DTA,
---- - Results of Philips (11)

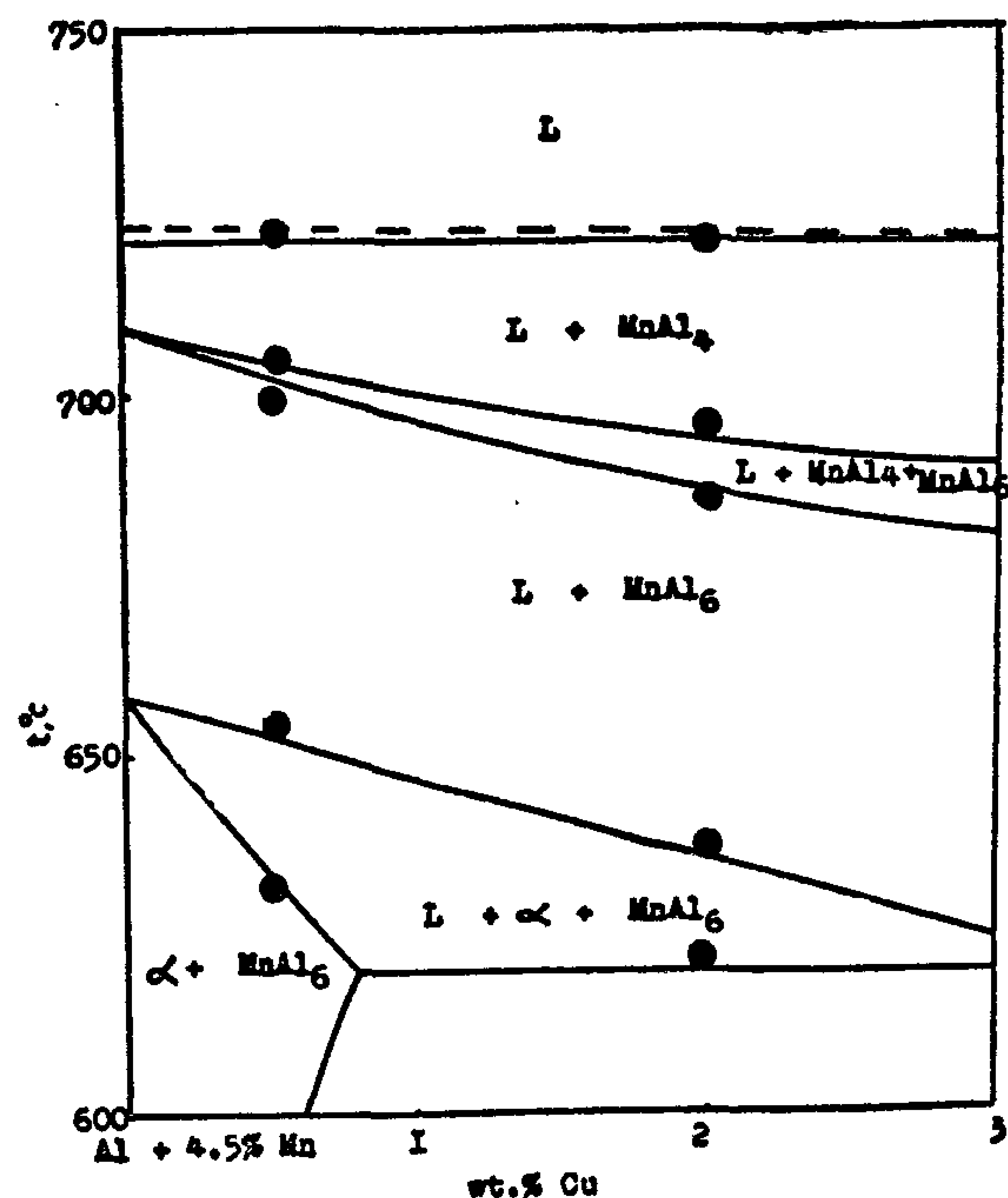


Fig. 7 : Vertical section at constant 4.5% Mn of Al-Cu-Mn System.
— - Results of Calculations,
● - Results of DTA
---- Results of Philips (11)

Table (2): Compositions of master alloys.

Nominal alloy	Element, percent by weight					
	Cu	Fe	Mn	Si	Zn	Al
50 Al - 50 Cu	49.75	0.38	<0.3	<0.15	<0.03	balance
90 Al - 10 Mn	<0.03	0.37	10.11	<0.1	<0.03	balance
90 Al - 10 Fe	<0.03	9.8	0.40	<0.15	<0.02	balance

Chemical analyses of the cast alloys showed that the nominal compositions agreed with weighed charges including the loss factors.

The experimental determination of critical temperatures is carried out using Differential Thermal Analysis «DTA». It should be noted that, the liquidus temperature is measured during cooling and the solidus temperature during heating in order to reach best equilibrium conditions. Comparison of calculated temperatures with the experimental results for the prepared alloys yielded good agreement as can be seen from tables (3,4).

Figures (6.7) show the experimental results of DTA measurements of critical temperatures of some alloys as well as results of Philiphs (II). It is possible to observe that a difference ranging between 2 to 3°C exists between calculated and experimental temperatures obtained either from the present investigation or reported elsewhere (11).

The used values for the enthalpy of melting (ΔH^M) and entropy of melting (ΔS^M) for Al, Cu, Mn and Fe were obtained from references (13,14). A computer program is used for the calculation of liquidus and solidus temperatures for a given alloy composition with accuracy of half degree.

The calculated critical temperatures of a considerable number of alloy composiions are used to construct the liquidus and solidus surfaces in the aluminum rich side Al-Cu-Fe and Al-Cu-Mn systems as shown in figures (2-5).

Some calculated vertical sections at chosen composition in both systems are also shown in figures (6,7).

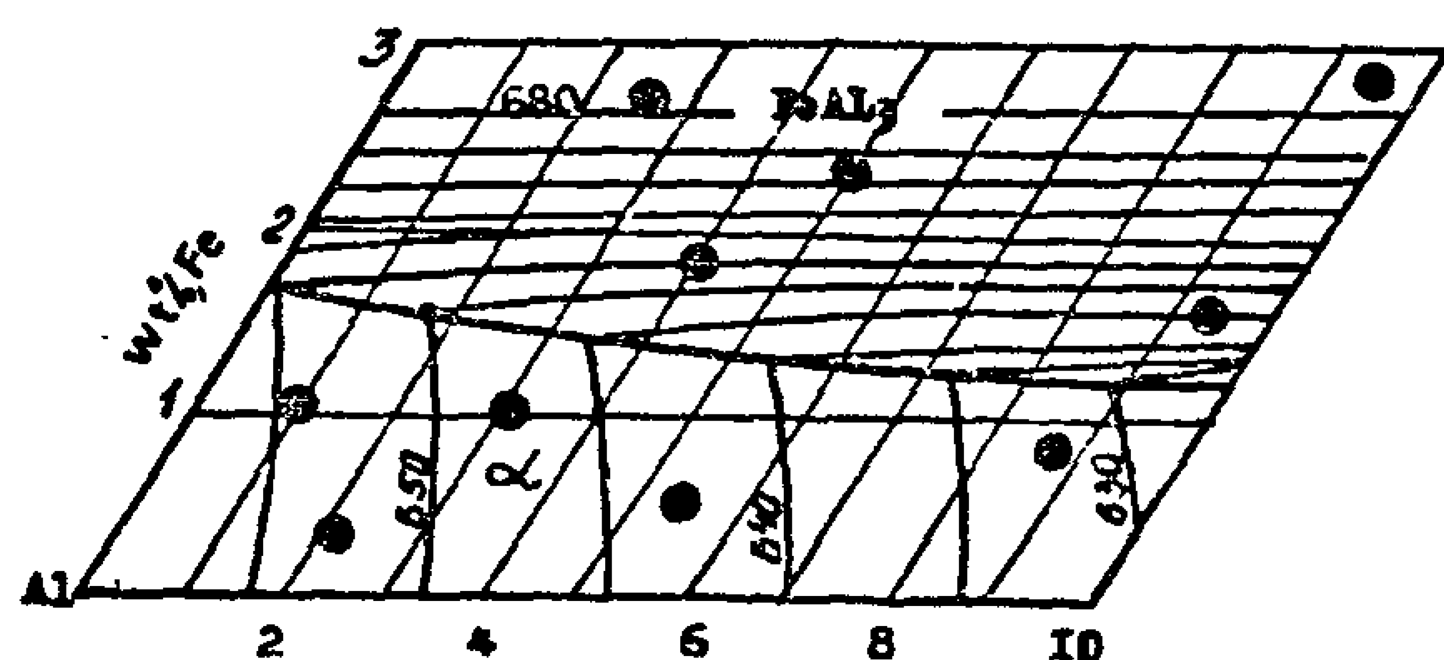


Fig. 2 : The liquidus surface in the alumnnum side Al- Cu - Fe system,

● - compositions of prepared alloys for the experimental study.

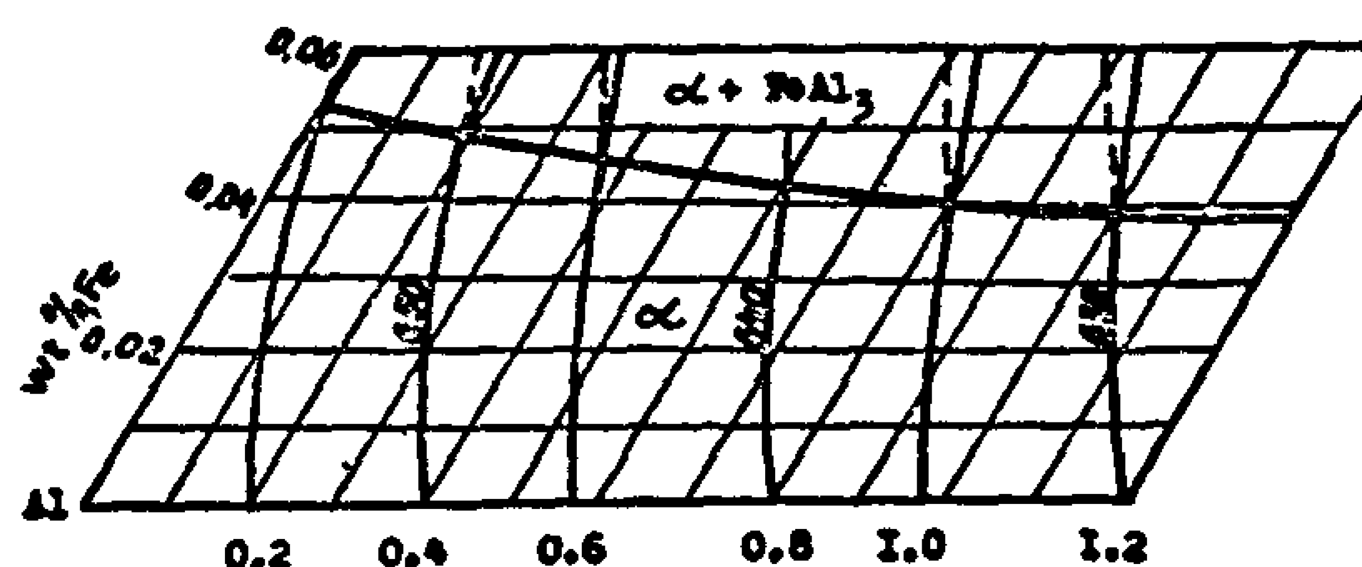


Fig. 3 : The solidus surface in the aluminum side of Al - Cu - Fe system.

EXPERIMENTAL PROCEDURES:

To be sure of results of thermodynamic calculations, ten alloys of different compositions (tables 3,4) for every system were prepared as described before (7) from pure aluminum (99.9% Al, 0.1% total Fe and Si) and master binary alloys containing known quantities of Cu, Mn or Fe as shown in table (2). Factors for melting losses of Cu, Mn and Fe were taken from reference (15).

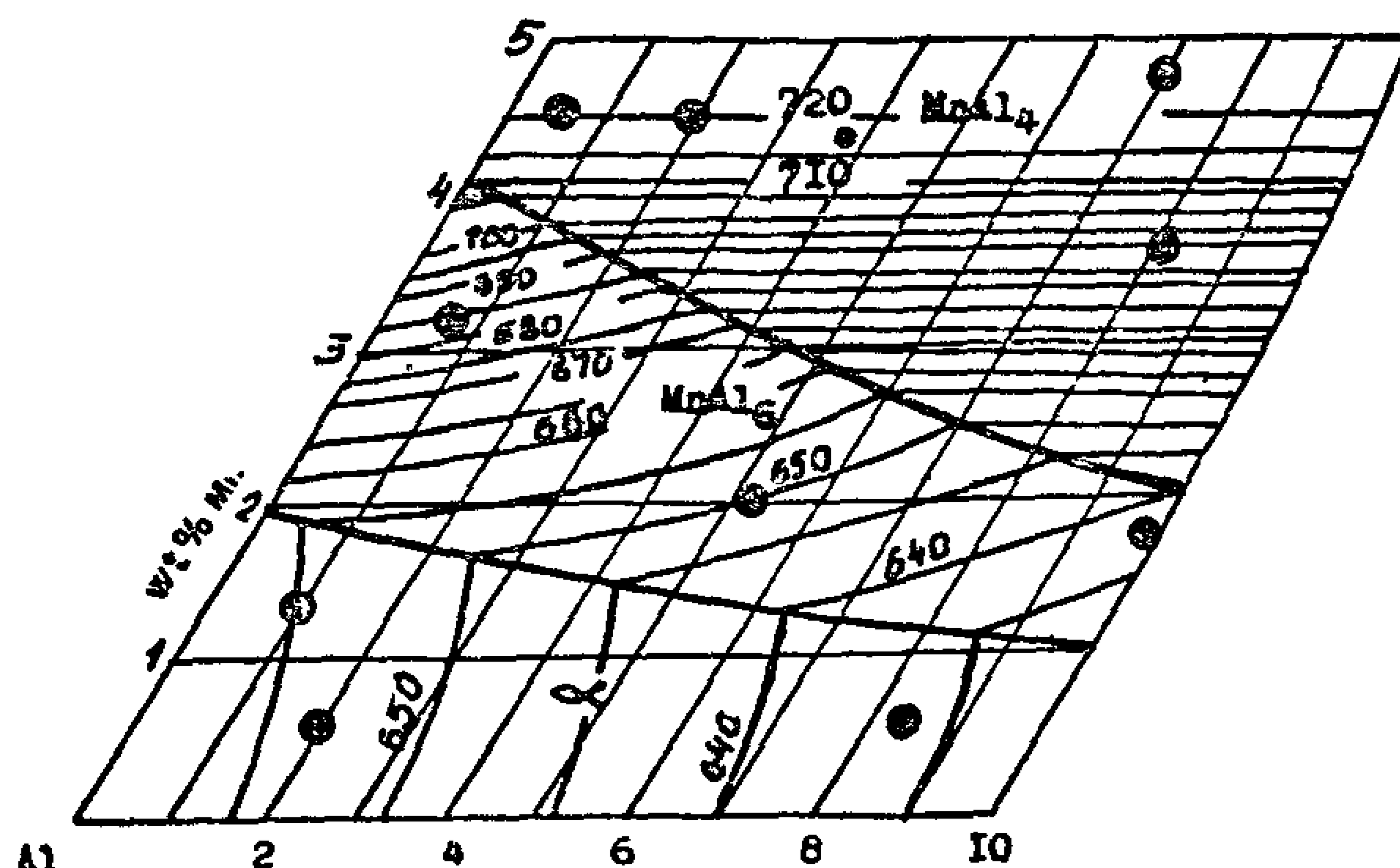


Fig. 4 : liquidus in the aluminum rich side.

Al - Cu - Mn system.

● - Compositions of prepared alloys for the experimental study.

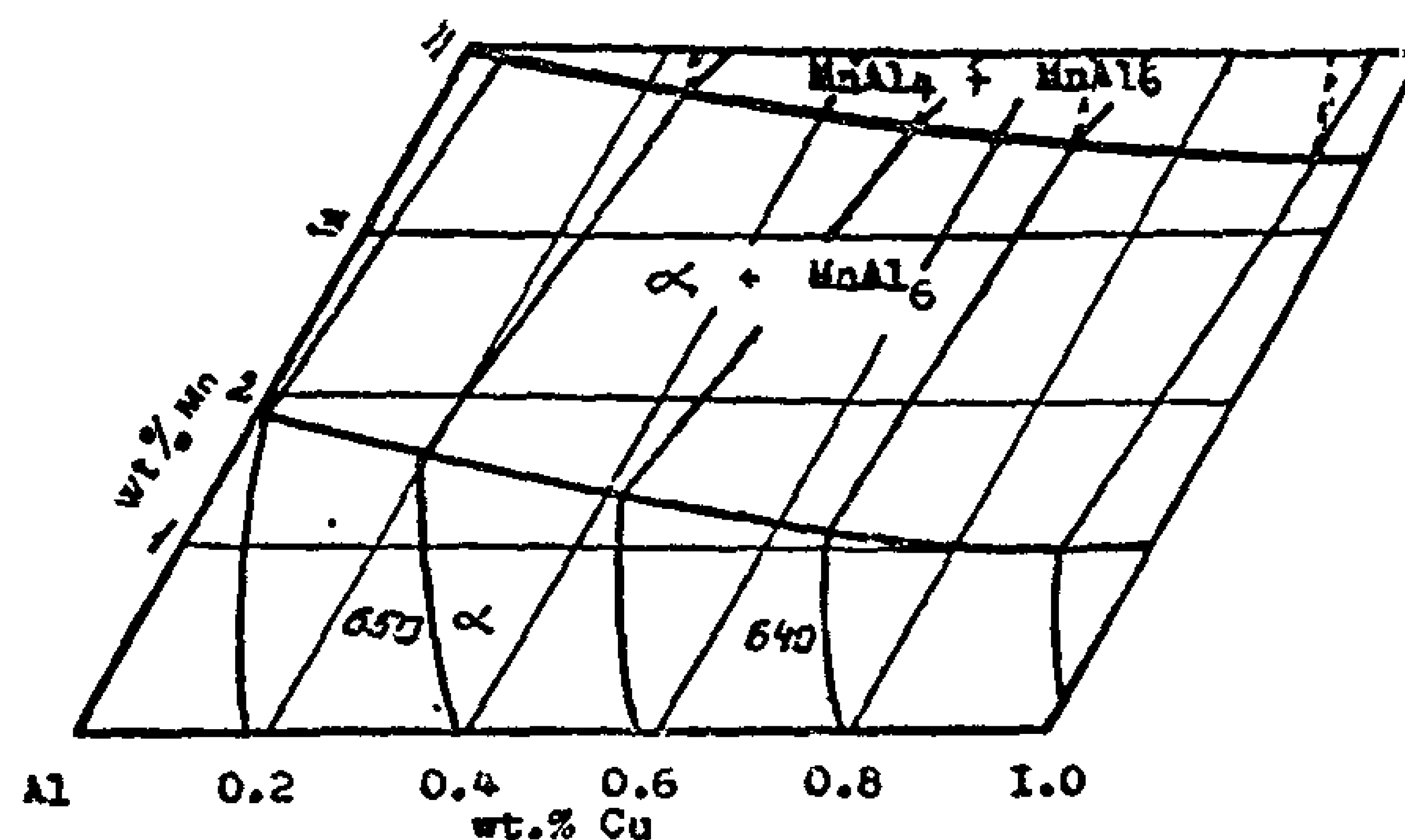


Fig. 5 : The solidus surface in the aluminum side Al - Cu - Mn system.

For the same reason $\Delta\mu^{ex}_{Cu}$ is also neglected for the equilibrium regions $L \rightleftharpoons MnAl_4$ and $L \rightleftharpoons MnAl_6$ in AL- Cu - Mn system.

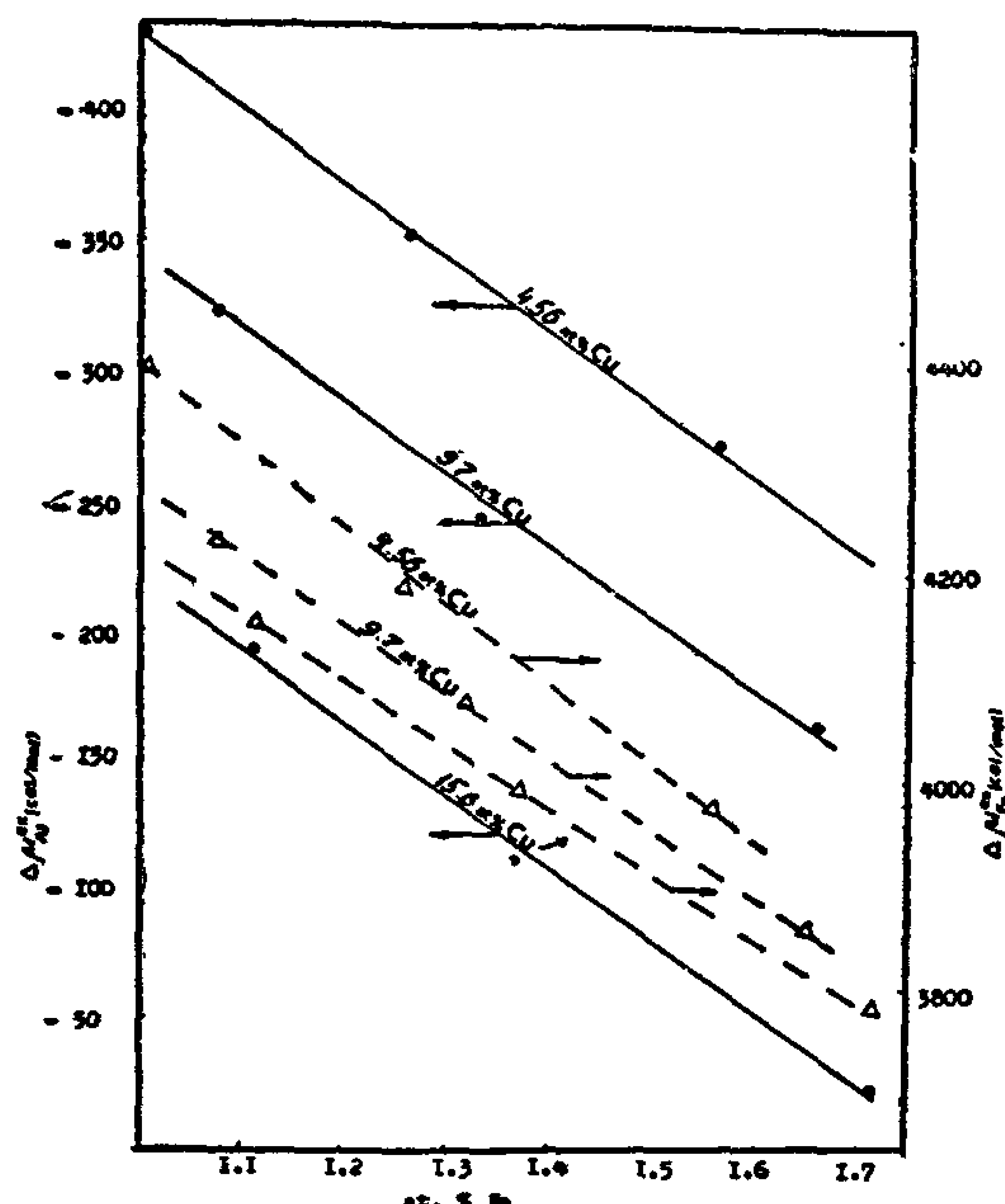


Fig. 1 : $\Delta\mu^{ex}_{Al}$ and $\Delta\mu^{ex}_{Fe}$ as a function of copper and iron atomic concentrations in the equilibrium region $L \rightleftharpoons FeAl_3$ of Al - Cu - Fe ternary diagram.

Fig. 1 was given as an example of the graphical representation of $\Delta\mu^{ex}$ of every individual component in each equilibrium region A least square analysis of the $\Delta\ \mu^{ex}$ (i)– composition data yielded the thermodynamic parameters for the chemical potential function of essential components Al, Cu, Mn and Fe for the three equilibrium regions :


$L \rightleftharpoons \alpha_A$, $L \rightleftharpoons MnAl_6$, $L \rightleftharpoons MnAl_4$

and for the two equilibrium regions $L \rightleftharpoons \alpha_{Ae}$, $L \rightleftharpoons FeAl_3$ in Al - Cu - Mn and Al- Cu — Fe systems as shown in table (1) respectively.

Table (I): The excess chemical potential of different components in Al - Cu - Mn and Al -Cu- Fe systems.

system	equilibrium region	$\Delta\mu^{ex}_{i}$	jol/mole
Al - Cu - Fe	$L \rightleftharpoons Al$	$\Delta\mu^{ex}_{Al}$	$= -1296X_{Cu} + 1880X^2_{Cu} - 45980X_{Cu}X_{Fe}$
		$\Delta\mu^{ex}_{Cu}$	$= -23889 + 6709X_{Al} - 12540X_{Fe}$
		$\Delta\mu^{ex}_{Fe}$	$= -34276 - 12540\ X_{Cu}$
	$L \rightleftharpoons FeAl_3$	$\Delta\mu^{ex}_{Al}$	$= -3260 + 7762X_{Cu} + 112320X_{Fe}$
		$\Delta\mu^{ex}_{Fe}$	$= -21140 - 4184X_{Cu} - 273930X_{Fe}$
Al - Cu Mn	$L \rightleftharpoons Al$	$\Delta\mu^{ex}_{Al}$	$= -1296X_{Cu} + 1880X^2_{Cu} - 4076X_{Mn}$
		$\Delta\mu^{ex}_{Cu}$	$= -23889 + 6709X_{Al}$
		$\Delta\mu^{ex}_{Mn}$	$= -8406 - 41141X_{Cu}$
	$L \rightleftharpoons MnAl_4$	$\Delta\mu^{ex}_{Al}$	$= -2189 + 49587X_{Mn} + 7249X_{Cu}$
		$\Delta\mu^{ex}_{Mn}$	$= -17295 - 201635X_{Mn} + 4579X_{Cu}$
	$L \rightleftharpoons MnAl_6$	$\Delta\mu^{ex}_{Al}$	$= -1864 + 70819X_{Mn} - 3016X_{Cu}$
		$\Delta\mu^{ex}_{Mn}$	$= -18642 - 402876X_{Mn} - 32732X_{Cu}$

$\Delta\mu_i^{ex}$ and $\Delta\mu_j^{ex}$ into equation (1) gives:

$$K_i = \exp\left((b_{i-j}(X_j^L) + c_{i-j}(X_j^L)^2 + \cdots - \Delta H_i^M + \Delta S_i^M T)/RT\right) \qquad (2)$$

$$K_j = \exp\left((a_j + b_{j-i}(X_i^L) + c_{j-i}(X_i^L)^2 + \cdots - \Delta H_j^M + \Delta S_j^M T)/RT\right)$$

In case of ternary system and during the equilibrium between liquid phase and solid solution

$\Delta\mu_i^{ex}$, $\Delta\mu_j^{ex}$ and $\Delta\mu_k^{ex}$ are given as follows:

$$\Delta\mu_i^{ex} = \Delta\mu_{i-j}^{ex} + \Delta\mu_{i-k}^{ex} + \Delta_i (X_j^L)(X_k^L)$$

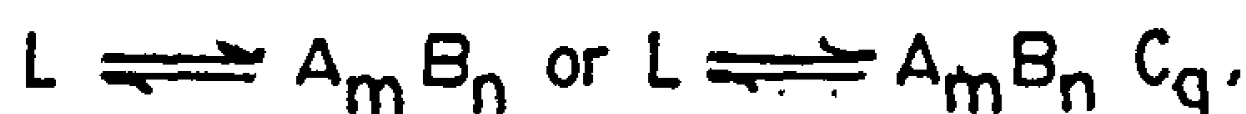
$$\Delta\mu_j^{ex} = \Delta\mu_{j-i}^{ex} + \Delta_j (X_i^L)(X_k^L) \qquad (3)$$

$$\Delta\mu_k^{ex} = \Delta\mu_{k-j}^{ex} + \Delta_k (X_i^L)(X_j^L)$$

where $\Delta\mu_i^{ex}$, $\Delta\mu_j^{ex}$ and $\Delta\mu_k^{ex}$ are the excess chemical potential of the three basic components of the ternary system under investigation,

X_i^L, X_j^L and X_k^L are atomic fractions of the i,j and k componts in the liquid phase and Δ are constants.

For equilibrium between liquid phase and chemical compound phase i.e.,



equation (I) can be applied for components i,j and k (6,7). To determine the liquidus temperature of a given alloy in a given binary (or ternary) system the condition:

$$\sum_1^2 X_i k_i = 1 \quad (\text{or } \sum_1^3 X_i k_i = 1)$$

should be satisfied, while for the solidus temperature the condition is given by:

$$\sum_1^2 X_i / k_i = 1 \quad (\text{or } \sum_1^3 X_i / k_i = 1)$$

The first study (6) demonstrated the usefulness of direct use of chemical potential function method by calculating four important ternary phase diagrams: AL-Cu-Mg, AL-Cu-Si, AL-Mg-Mn and AL-Mg - Fe. In the previous publication (7) the same principle was used for a thermodynamic analysis of AL-Mg-Si ternary system.

The present work was carried out along similar lines to the previous analyses of ternary systems (6,7) to generate significant number of polythermal sections of previously thermodynamically uncomputed ternary systems such as AL-Cu-Mn and AL-Cu-Fe.

The obtained expressions for chemical potential function of the investigated diagrams could be used for a further larger thermodynamic study of industrial importance AL-Cu-Mn-Fe and AL-Cu-Mg-Fe quaternary systems.

RESULTS OF THERMODYNAMIC COMPUTATIONS:

Experimental data of a limited number of alloys (not more than nine alloys in every equilibrium region) with various compositions given by Philips (II) and Hanemann (12) was used for calculating the chemical potential function of the essential components.

Fig. I shows a graphical representation of

$\Delta\mu_{Al}^{ex}$ and $\Delta\mu_{Fe}^{ex}$

as a function of Cu and Fe concentration in the equilibrium region



The $\Delta\mu_{Cu}^{ex}$ for $L \rightleftharpoons FeAl_3$ equilibrium region is neglected since copper solubilty in solid $FeAl_3$ phase is negligible.

THERMODYNAMIC CALCULATION OF AL-Cu-Mn and AL-Cu-Fe TERNARY EQUILIBRIUM DIAGRAMS

M.I. Abbas*

ABSTRACT

Previously published descriptions of thermodynamic calculations for binary and ternary equilibrium diagrams have employed to compute significant number of polythermal sections in technical important ternary systems AL-Cu-Mn and AL-Cu-Fe with up to 3;5 and 10 wt percentage of iron, manganese and copper respectively.

Liquidus and solidus surfaces for the given systems are also constructed.

Comparison of the calculated polythermal sections with the experimental results obtained by Differential Thermal Analysis «DTA» measurments yields good agreements.

INTRODUCTION:

Utilization of Computer-based methods for calculation of binary and ternary phase diagrams has been facilitated by developing explicit descriptions either, of the lattice stability of the pure components (1-5) or, for the excess chemical potential function of each individual component existing in solution and compound (6-10).

The change in the excess chemical potential function could be directly used to compute isothermal sections for the ternary systems (8-10), as well as polythermal sections (6,7) which have more importance for alloy makers and users.

It has been shown in the previous study (6) and publication (7), that, the change in the excess chemical potential. for component i ($\Delta\mu_i^{ex}$) during equilibrium between the liquid (L-phase) and the solid (α-phase) in a binary diagram can be written as follows :

$$\Delta\mu_i^{ex} = \Delta H_i^M - T\Delta S_i^M + RT \ln K \quad (1)$$

where

ΔH_i^M and ΔS_i^M are the melting enthalpy and entropy of component i respectively, K is the distribution coeffecient at temperature T and equals X_i^{α}/X_i^L

From the graphical relation between the excess chemical potential for the basic component i ($\Delta\mu_i^{ex}$) and the mole fraction of the alloying component j in the liquid phase (X_j^L):

$$\Delta\mu_i^{ex} = b_{i-j}(X_j^L) + c_{i-j}(X_j^L)^2 + \dots, \text{ and}$$

for the alloying ellement j :

$$\Delta\mu_j^{ex} = a_j + b_{j-i}(X_i^L) + c_{j-i}(X_i^L)^2 + \dots$$

where a, b,... are thermodynamic parameters of atomic interaction between i and j components of the given binary system. Substituting the values of

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Acknowledgement

The auther wishes to express his gratitude to Prof. Dr. SAYED A. SALEH, Faculty of Engineering, Cairo University for critical reading the manuscript and valuable comments.

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Table (1) shows the average of the main properties of the three zones making up the studied section (Pay zone).

Table (1)

Zone	V_{sh} %	Φ_D %	α	C_b 10^{-7}	ν	P_f/D Psi/Ft
3	11.27 ±0.60	13.72 ±0.42	0.272 ±0.10	2.40 ±.08	0.283 ±.012	0.822 ±.038
2	47.94 ±1.25	9.49 ±0.18	0.181 ±0.12	2.27 ±0.02	0.302 ±.004	0.880 ±0.011
1	6.50 ±0.44	9.65 ±0.49	0.151 ±0.06	2.17 ±0.09	0.279 ±0.012	0.789 ±0.033

An approximate value for the compressibility parameter, α , equals twice the density derived porosity, Φ_D, can be satisfactorily applied in fracture pressure gradient equation.

A simple linear relation between fracture pressure gradient and shale index is concluded (fig. 5). This gradient is governed by two formation properties, namely, Poisson's ratio and porosity. For clean sandstone intervals, in the area under study, a fracture pressure gradient of 0.77 Psi/Ft is determined. As shale content increases, this gradient increases. When dispersed shale content reaches its limiting value in shaly sands (nearly 40%), shale index will be equai to 1. For such an interval, a fracture pressure gradient of approximately 1.3 Psi/Ft is anticipated. Therefore, this work is only applicable to dispersed shaly sands (less than ± 40% shale) and can not be reliable for laminated or massive shales.

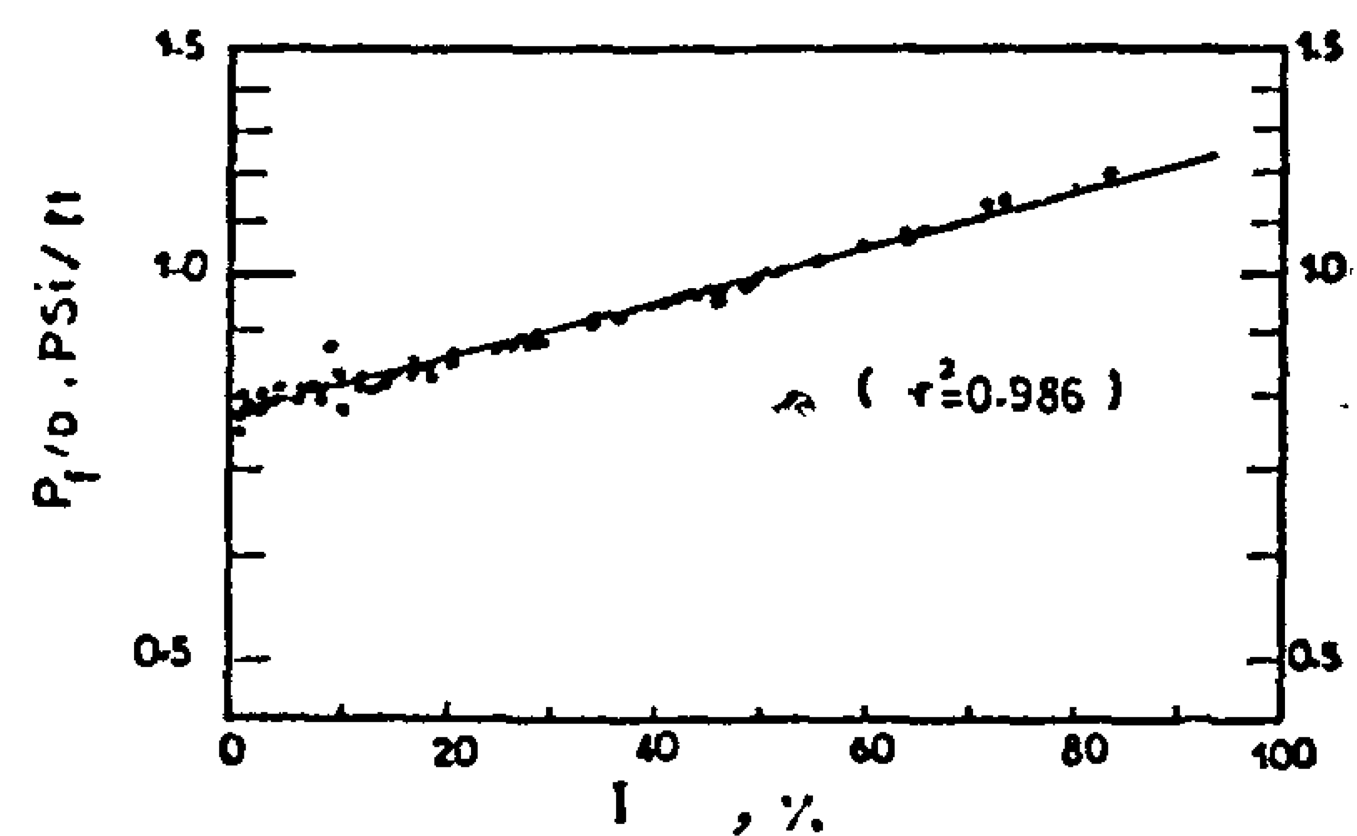


Fig. (5) - Fracture Pressure gradierrt vs Shale index

Nomenclature

C_b = bulk compressiblity

C_r = intrinsic compressibility

D = depth

I = dispersed shale index

K = bulk modulus

P_f = fracture pressure

P_o = overburden pressure

P_p = pore pressure

V_{sh} = shale content

α = a rock compressibility parameter = $1 - C_r/C_b$

Δt = sonic transit time (time for first arrival to travel 1 Ft)

Δt_c = compressional wave transit time

Δt_s = shear wave transit time

ν = poisson's ratio

ρ_b = bulk density

ϕ_D = porosity derived from density log

ϕ_N = porosity derived from neutron log

ϕ_e = porosity available to water and hydrocarbons

ϕ_t = total space between the matrix grains supporting the overburden

In this study, clay parameters, estimated from crossplots, are compatible with that of Kaolinite and the heavy clay density is explained by the presence of small amounts of heavier iron pyrite compounds (Rose et al, 1985).

Rock compressibility parameter, α,.

The presence of this parameter in the fracture pressure gradient equation (1) represents a porosity dependence that attenuates the importance of the pore pressure term. There is no agreement on the manner in which α is related to porosity (Anderson et al, 1973).

To evaluate this parameter, in the present study, the intrinsic compressibility, C_r, (for sand grains) is taken as a constant equals 1.86×10^{-7} Psi^{-1} (Kaye and Laby, 1973). Bulk compressibility, C_b, is computed according to the technique devised by Schlumberger in 1980 relating it to the compressional wave transit time, (Δt_c), the bulk density, (ρb) and Poisson's ratio, ν as follows :

$$\frac{1}{C_b} = K = 1.34 \times 10^{10} \times \frac{1+\nu}{3(1-\nu)} \times \frac{\rho b}{(\Delta t_c)^2} \; Psi \quad (4)$$

In this equation, the coefficient, 1.34×10^{10}, adjusts for units where

ρ_b is in g/cc and Δt_c is in microsec/Ft.

The elastic constant (K), bulk modulus, is dynamically determined from sonic (Δt_c) and density (ρ_b) measurments made downhole.

Results and Conclusions

Figure (4) illustrates the log data given (Gamma Ray, GR, Neutron derived porosity Φ_N bulk density, ρ_b, and transit time Δt) and the computed parameters (Poisson's ratio, ν, bulk compressibility, C_b and fracture pressure gradient P_f/D)

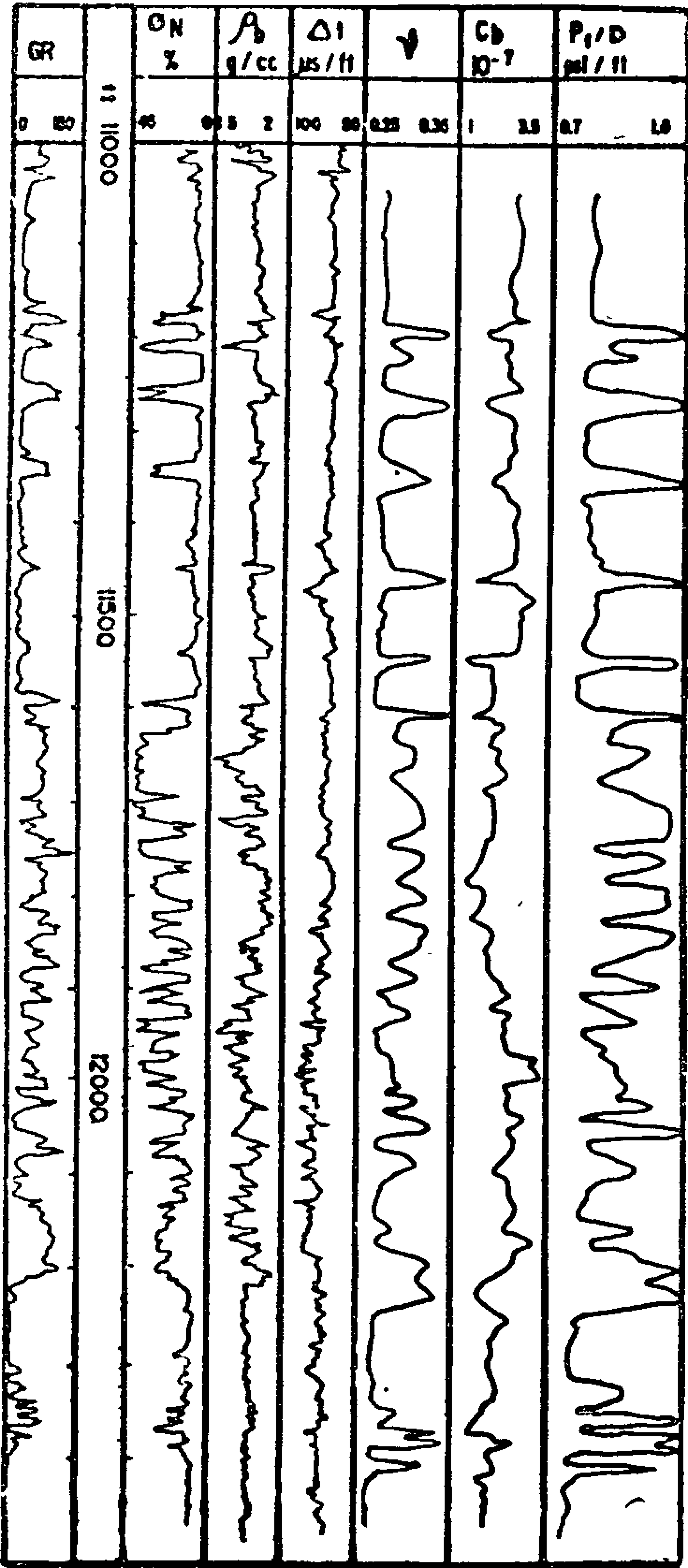


Fig. (4) - Log data and computed parameters

$$I = \frac{\varphi_t - \varphi_e}{\phi_t} \qquad (3)$$

where

ϕ_t is the total space between the matrix grains supporting the overburden.

ϕ_e is the porosity available to water and hydrocarbons.

$\phi_t - \phi_e$ is interperated as the intergranular space occupied by the dispersed shale and fines

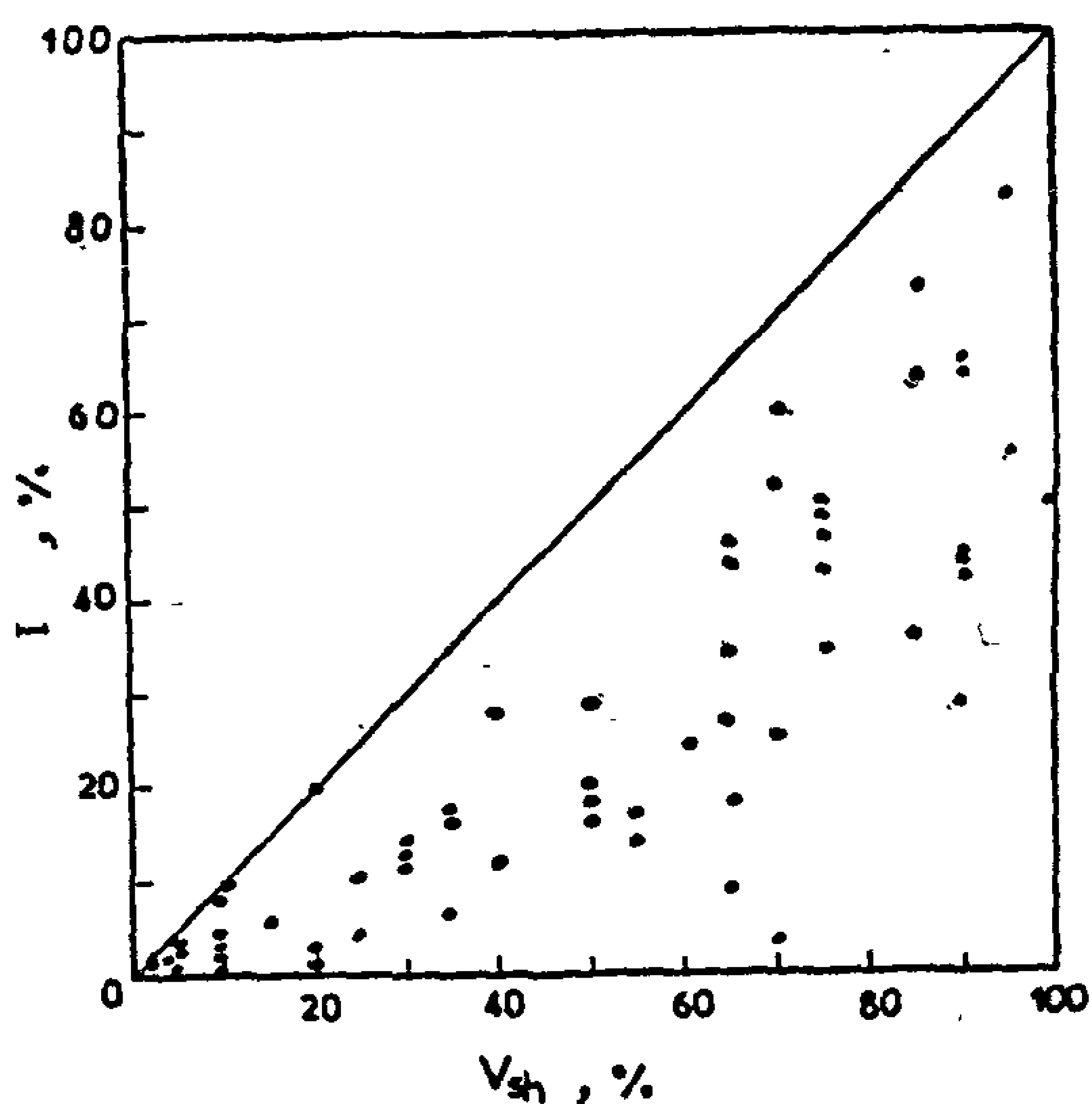
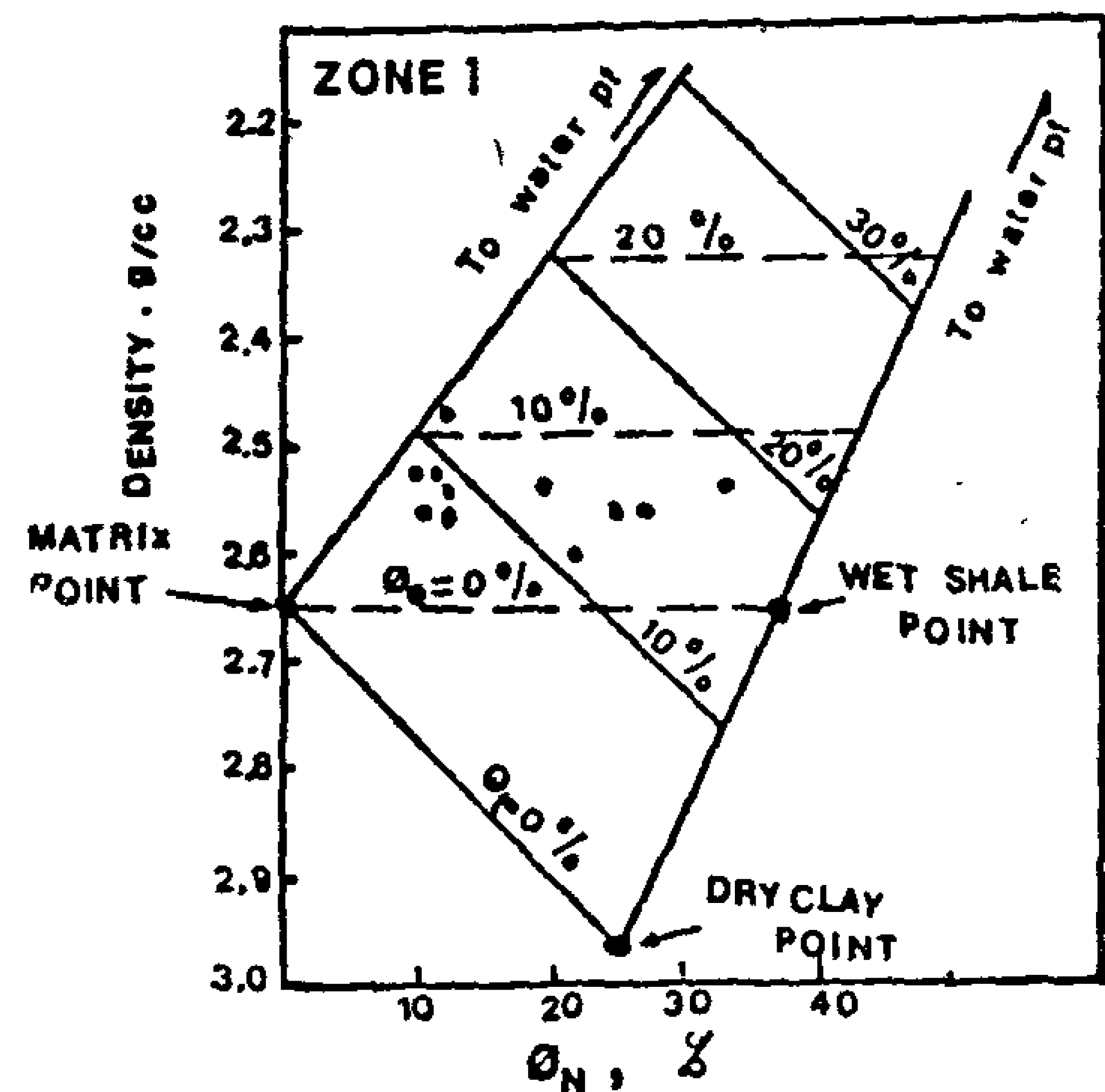
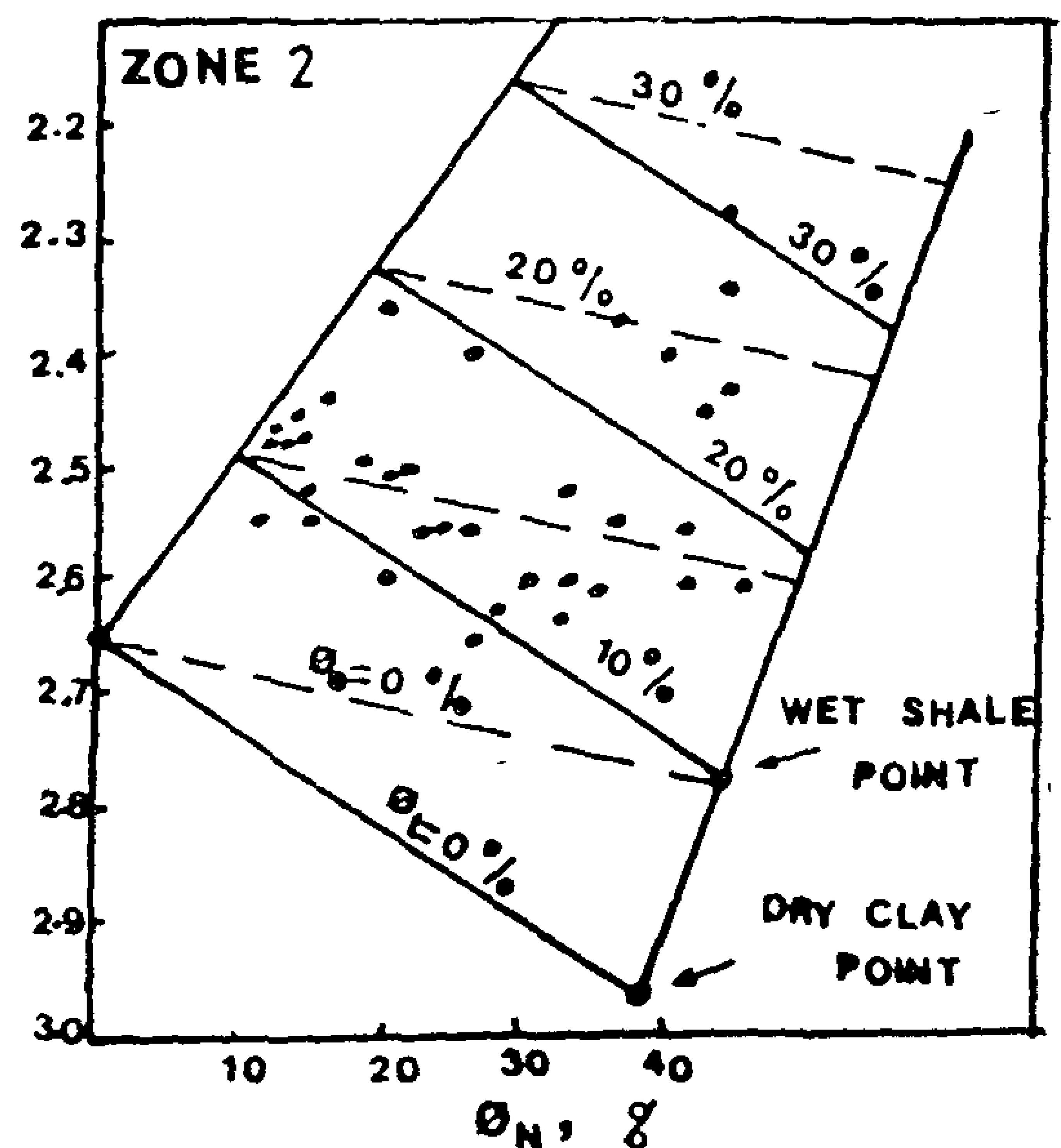


Fig. (2) Shale index vs Shale content

Total and effective porosity are derived from a neutron-density crossplot (fig. 3). Three reference points are defined, the matrix point (ϕ_N= 0 %, ρ_b= 2.65 g/c.c), the water point (ϕ_N= 100 %, ρ_b= 1 g/c.c) and the dry clay point. For dry clay, density ranges between 2.5 and 3.1 g/cc and owing to chemically bound hydrogen, it have hydrogen indices between 0.13 and 0.35 (Poupon et al, 1970). The shale under formation conditions is reffered to as "wet shale". The wet shale point is located on the line joining the dry point and the water point.





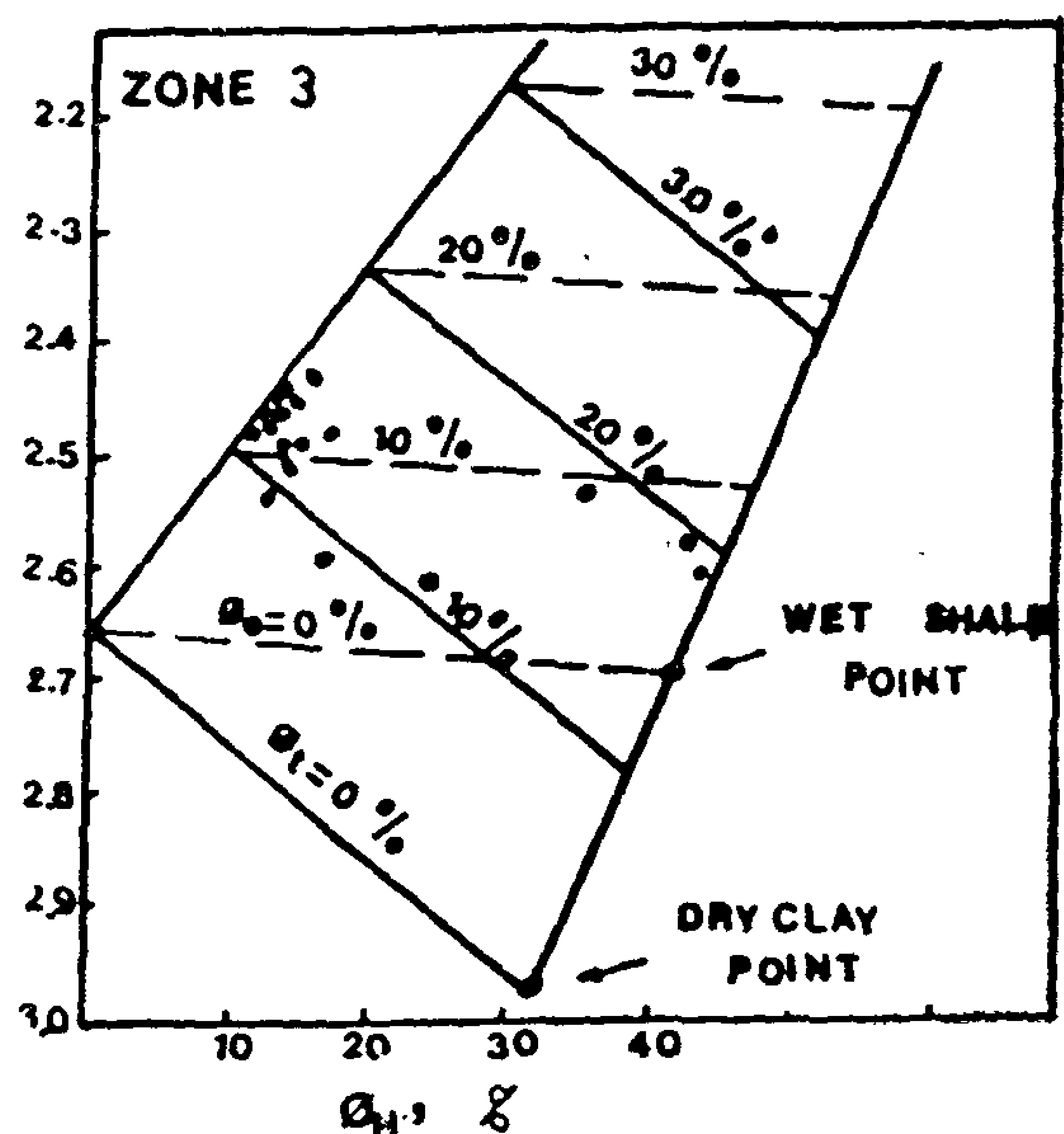


Fig. (3) - Neutron-Density Crossplot for effective and total porosity determination

Pore pressure can be obtained using a convenient logging method or it can be measured directly. For the same area, pore pressure gradient is equal to 0.49 Psi /Ft.

The objective of this study is to improve the reliability of the results in fracture pressure gradient calculations in the producing sandstone in Ras Budran oil field, Gulf of Suez. Both Poisson's ratio (ν) and rock compressibility parameter (α) and their variations with depth are determined from well logs os follows :

Poisson's ratio, ν,.

In shaly sands, shale acts as a plastic agent. Therefore, its presence in sand increases Poisson's ratio. Shale content can be estimated using gamma ray log (GR) and various combinations of Sonic (Δ t), Density (ρ_b) and Neutron (ϕ_n) logs.

Figure (1) represents the log data for the productive sandstone section in a well in the field under investigation. This section can be subdivided, on shale content basis, into three zones.

Zone 1 (12480 - 12200 ft); is composed entirely, of clean massive sandstone.

Zone 2 (12200 - 11600 ft); is composed of sandstone with intercalated shales.

Zone 3 (11600 - 11000 ft) is mainly sandstone interbedded with shales at its middle part.

A plot of shale index, I, versus shale content V_{sh}, determined from gamma ray (GR) log. (fig. 2), reveals that (I/V_{sh}) ratio is appreciably different than unity, the condition assumed for laminated shale, and a dispersed clay occurrence is indicated (Alger et al, 1963). A relation between Poisson's ratio, ν, and shale index, I, is give by the following empirical formula (Schlumberger, 1980).

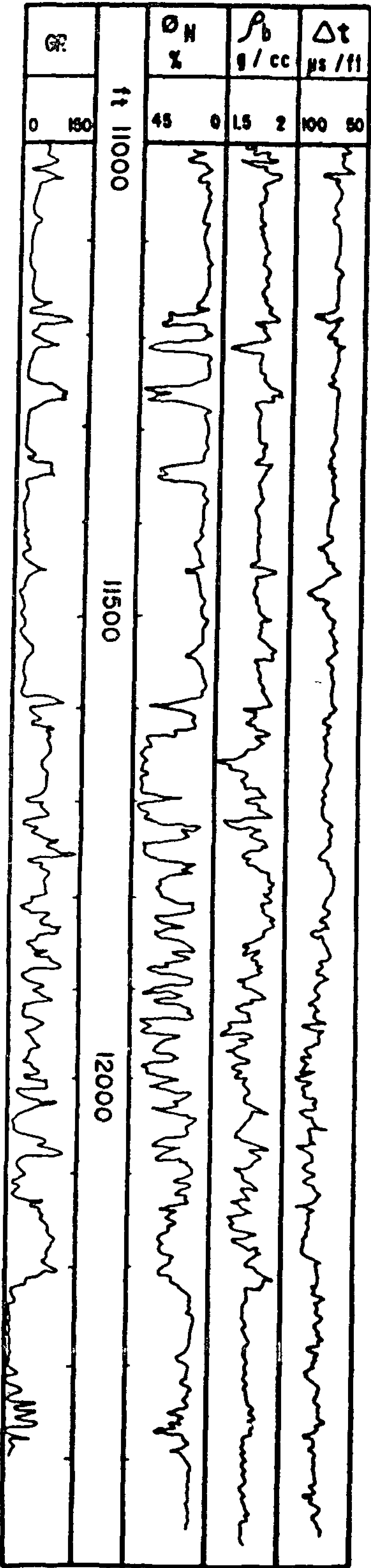


Fig. (1) Log data (well RB A1).

$$\nu = 0.124\ I + 0.27 \qquad (2)$$

where I, dispersed shale index, is defined by Alger et al in 1963 as

FRACTURE PRESSURE DETERMINATION IN RAS BUDRAN OIL FIELD, GULF OF SUEZ

NABIH A. ALSAYED *

Abstract

The knowledge of fracture pressure gradient in oil wells facilitates avoiding and overcoming many problems. The prediction of this gradient, for the producing sandstone section in Ras Budran oil field, Gulf of Suez, is the subject of this study. For computing such gradient, porosity and Poisson's ratio as formation properties as well as overburden and pore pressure gradients are taken into account. These variables are evaluated from well logs reflecting insitu conditions on calculated parameters.

Introduction :

In oil industry operations, many problems associated with the prediction of formation fracture pressure gradient are generally encountered. The troublesome and expensive problem of lost circulation could be avoided if techniques for calculating fracture pressure gradient are employed in well plans. Many decisions (mud weight, when and where to set a casing, surface treating pressures and required horspower in hydraulic fracturing, determination of allowable injection pressure in water flooding) require an accurate knowledge of both pore pressure and fracture pressure gradients.

Several methods are used to determine fracture pressure gradient (Hubbert and Eillis, 1957 and Eaton, 1969 and others). In each of these different techniques, formation properties that influence the fracture pressure either are ignored or are assumed to be, only a function of depth.

However, at a given depth in the same geological field, fracture pressure gradient can vary significantly. Therfore, it is not a monotonic function of depth but also a function of overburden pressure, pore pressure, Poisson's ratio and the ratio of the compressibility of the rock. Anderson et al, in 1973 suggested the following relation :

$$P_f/D = \left(\frac{2\nu}{1-\nu}\right)\frac{P_o}{D} + \alpha\left(\frac{1-3\nu}{1-\nu}\right)\frac{P_p}{D} \quad (1)$$

Where

P_f = Fracture pressure

D = Depth

ν = Poisson's ratio

P_o = Overburden pressure

P_p = Pore pressure

α = Rock compressibility parameter

$$= 1 - \frac{\text{intrinsic compressibility of rock grains, } C_r}{\text{bulk compressibility of porous rock, } C_b}$$

Values of fracture pressuure gradient computed using this equation can be displayed as a computed log.

Values of P_o/D, P_p/D, ν and α must be determined.

Overburden pressure gradient, P_o/D, due to overlying sediments can be computed by integrating the density log from surface to datum. The estimate of this integration yields a net overburden pressure gradient, for the area under study, very close to 1.0 Psi/Ft (Rose et al, 1985)

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CONCLUSIONS

The following conclusions were obtained from this work:

1. Interfacial tension between South Geisum crude oil (highly acidic) and alkaline (NaOH) solutions of formation water salinity at 25°C temperature decreases with increasing NaOH concentration until it reaches a minimum at 3 — 4% by weight NaOH concentration after which it increases again with further increase in the alkali concentration.

2. Contact angle measurements under the conditions of formation water salinity and a temperature of 25°C indicated a preferentially oil-wet system.

3. Alkaline NaOH waterfloods recover more oil than does the conventional waterflood. This increase in ultimate oil recovery is evidence by either production of a large oil-water bank or a delayed oil production.

4. At early stages of displacement, oil recovery increases with increasing NaOH slug concentration until it reaches a maximum at 4% by weight NaOH. Also, at such early stages, an excessive increase in NaOH concentration results in lower oil recovery. On the other hand, after injection of many pore volumes of displacement water, oil recovery is almost the same regardless of the NaOH concentration.

5. At 4% by weight NaOH slug concentration and 25°C temperature, oil recovery increases with increasing NaOH slug size until it reaches a maximum at 15% PV after which further increase in slug size results in decreasing oil recovery.

6. At applied conditions of 15% PV slug size, 4% by weight slug concentration and 25°C temperature, sodium hydroxide slug produces more oil recovery than does sodium carbonate slug.

7. Other conditions being the same, oil recovery increases with increasing temperature and with decreasing oil viscosity.

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This result indicates that the alkaline waterfloods carride out at the ambient temperature of 25°C are comparable and can be genralized at a higher temperature of 55°C with only a diffierence due to mobility ratio change.

Effect of Oil Visocity:

In order to further investigate the effect of mobiliy ratio on the displacement efficiency, South Geisum crude oil visocity was adjusted to a lower viscosity of 5.5 cp by mixing the crude oil with kerosene at a 50% ratio.

Fig. 15 represents the production history for South Geisum crude oil (138 cp) and Geisum crude mixed with kerosene (5.5 cp) at the same temperature of 25°C. This figure shows that oil recovery increases with decreasing crude viscosity (i.e. decreasing mobility ratio). For example, at 1.0 PV water injected, oil recovery at the high viscosity flood was 22% of the initial oil-in-place, while at low viscosity flood the recovery was 65% of the initial oil-in-place. The water-oil relative permeability is much higher in the case of using high viscosity crude oil and hence lower displacement efficiency was obtained.

Fig. 16 shows the production history of alkaline water displacement runs with 1% NaOH slug concentration and 15% PV slug size using South Geisum crude oil (138 cp) and oil-kerosene mixture (5.5 cp) respectively. Oil recovery increases with decreasing crude oil viscosity. On the other hand, from production history, it is noticeable that after 1 PV of displacement water injected, water-oil ratio is higher in the case of using low viscosity crude than in the high viscosity flood. This can be attributed to the difference in interfacial tension between the alkaline solution and both crude oil and crude-kerosene mixture.

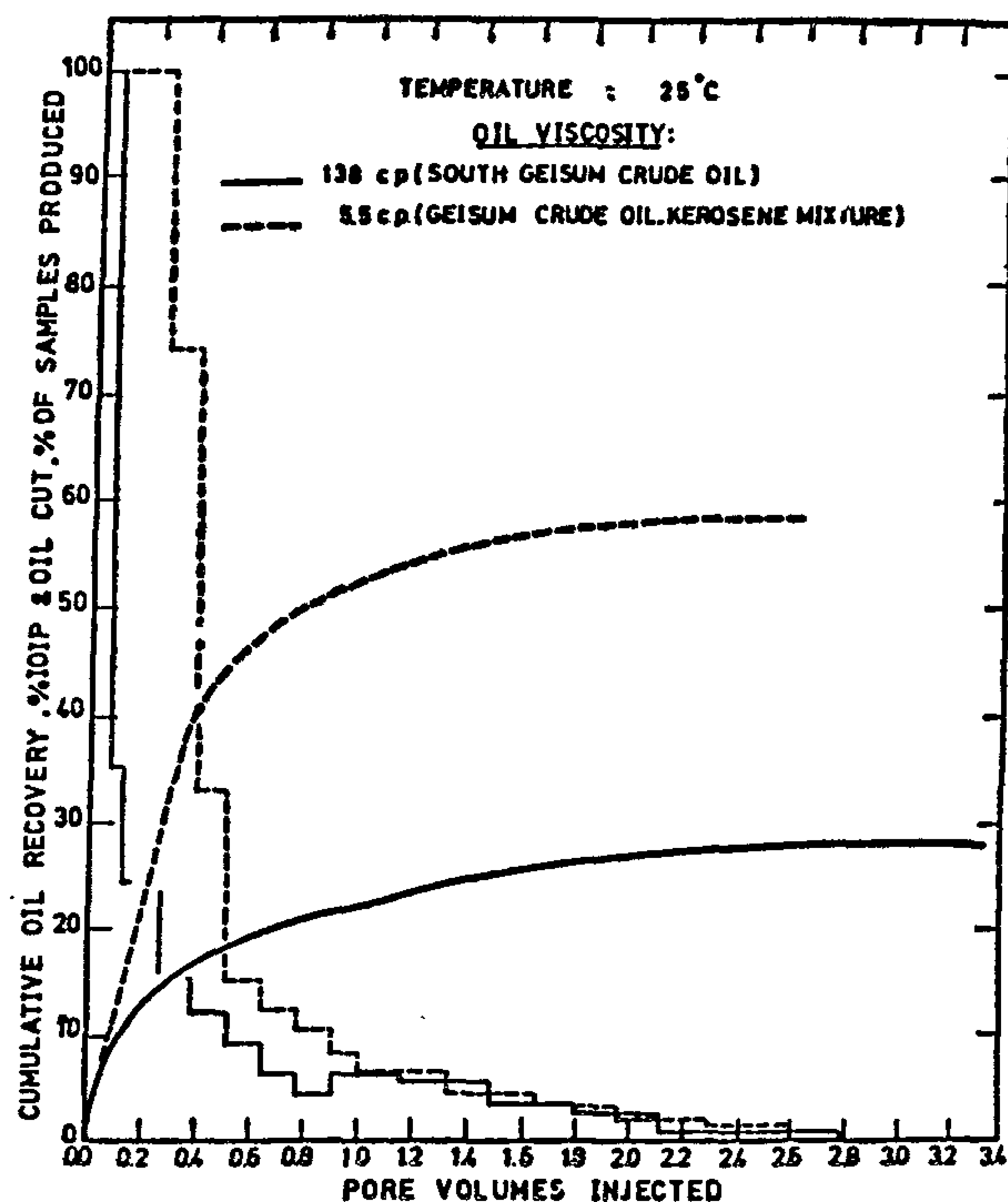


FIG. 15: EFFECT OF OIL VISCOSITY ON OIL RECOVERY BY CONVENTIONAL WATERFLOOD.

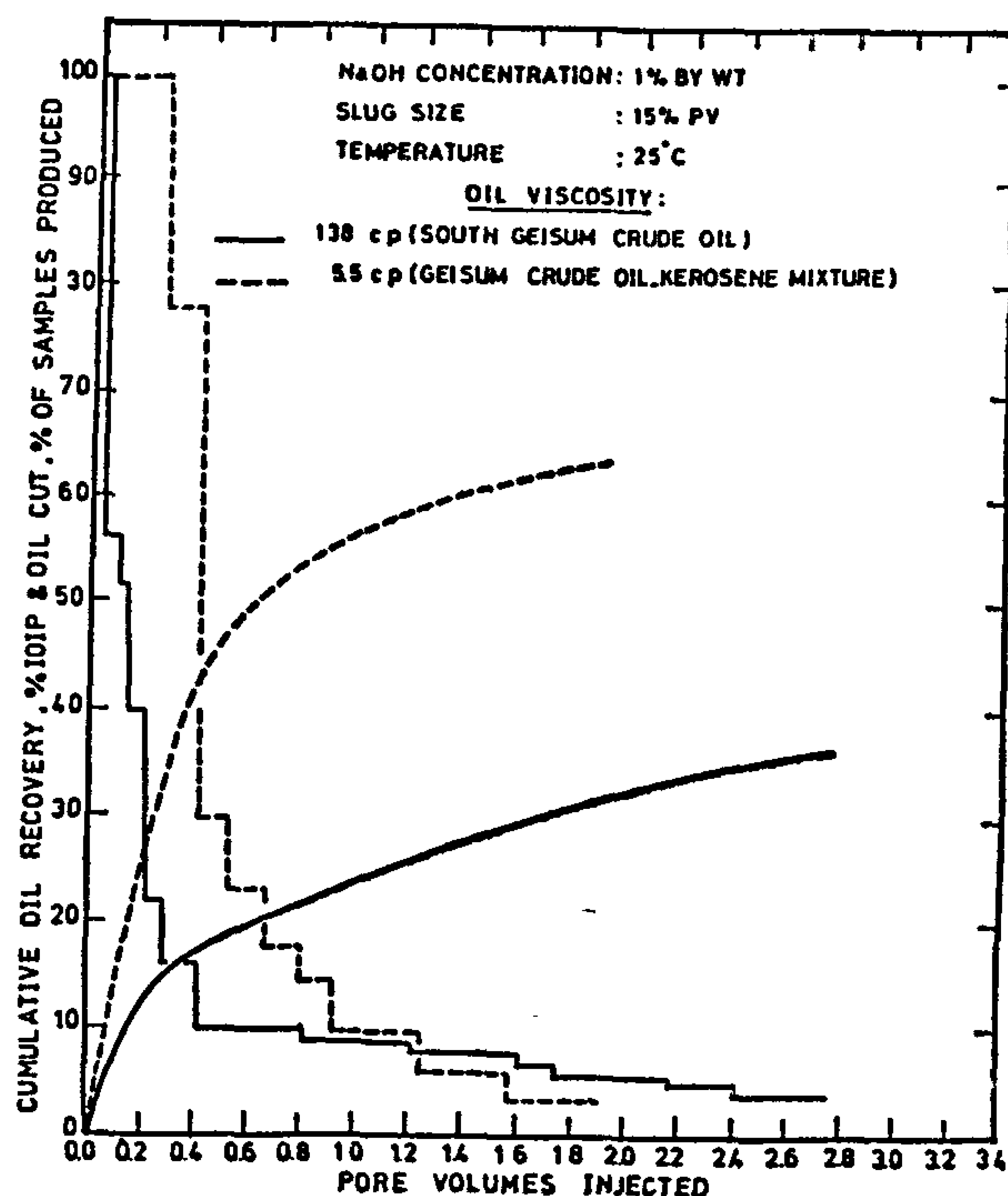


FIG.16: EFFECT OF OIL VISCOSITY ON OIL RECOVERY BY ALKALINE WATERFLOOD.

As is known from the literature, the solid-water interfacial tension depends on the pH value. Since under the present experimental conditions, the solid-oil interfacial tension has a constant value and the oil-water interfacial tension was nearly the same whether NaOH or Na2CO3 was used (as shown in Fig. 12), then the solid-water interfacial tension was altered by the change of the pH value of the solution used and as a result of this variation a different oil recovery was obtained in each.

Effect of Temperature on the Displacement Process:

In general, temperature plays an important role in alkaline waterflood. It affects the interfacial tension and wettability properties of the liquid-rock systems. It also affects, to a great extent, the viscosity of the fluids in the porous medium leading to remarkable changes in the mobility control of the process and hence in oil recovery.

Fig. 13 shows the production histories of two alkaline waterflood under the same conditions of 4% by weight NaOH concentration and 15% PV slug size but at two different temperature levels of 25° and 55° C respectively. In order to cancel the effect of oil expansion on the recovery mechanism as a result of increasing temperature, the formation water saturation process as well as the oil saturation one were carried out at the same temperature. Also, the recovery calculations were based on the oil produced at the same temperature.

It is seen from Fig. 13 that a great increase in oil recovery was obtained when temperature increased from 25° to 55° C.

To explain the effect of temperature on South Geisum crude oil displacement efficiency, the contact angle and interfacial tension were measured at 55°C temperature. As shown in Fig. 14 no great change in the contact angle was observed as a result of increasing temperature. From Fig. 5 which shows the interfacial tension between oil and alkaline solutions at both 25°C and 55°C, it can be seen that interfacial tension increases slightly with increasing temperature. Therefore, it can be said that the increase in oil recovery at the higher temperature of 55°C is a result of the better mobility ratio between oil and displacement water due to decreasing oil viscosity.

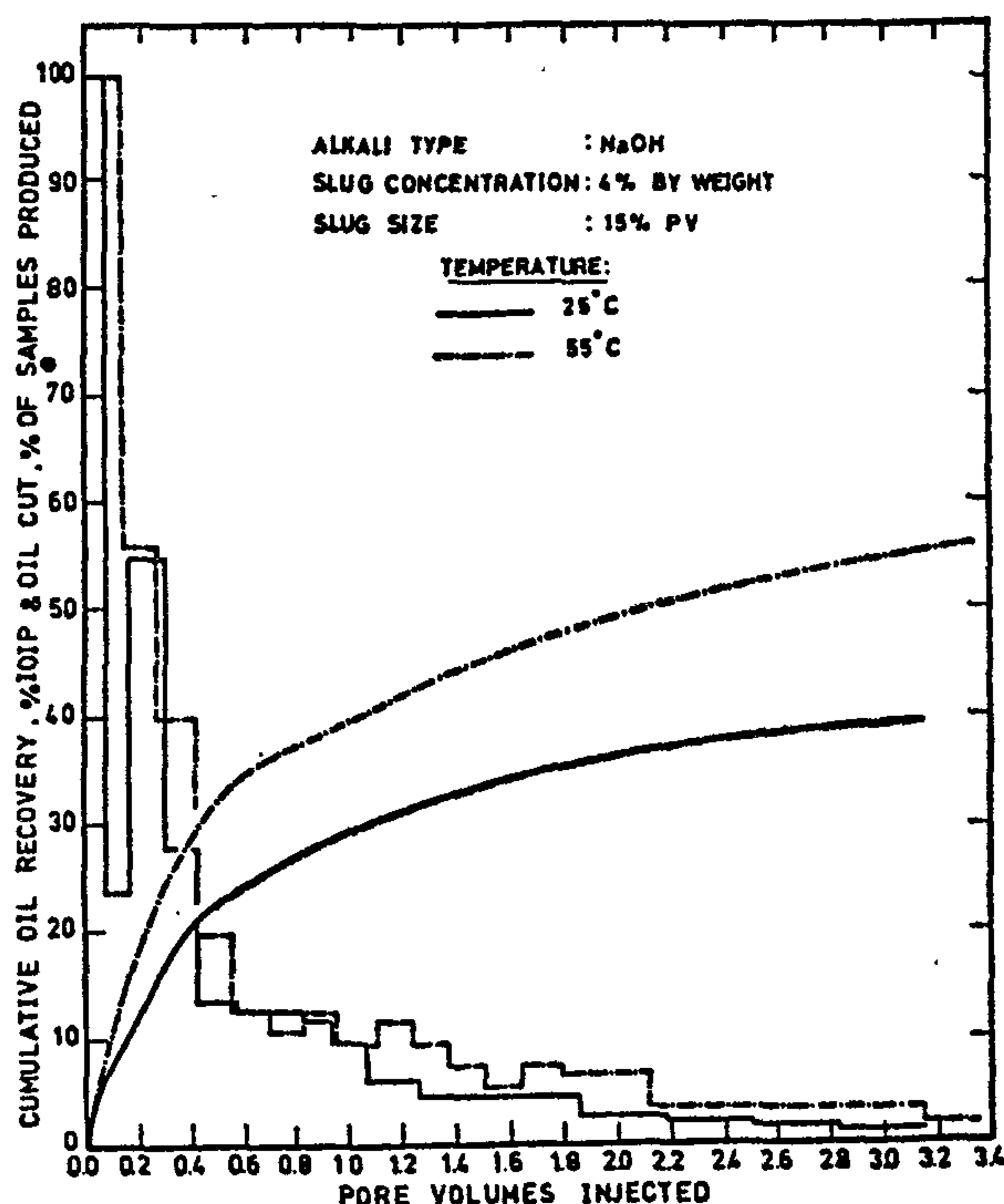


FIG.13 : EFFECT OF TEMPERATURE ON OIL RECOVERY BY ALKALINE WATERFLOOD.

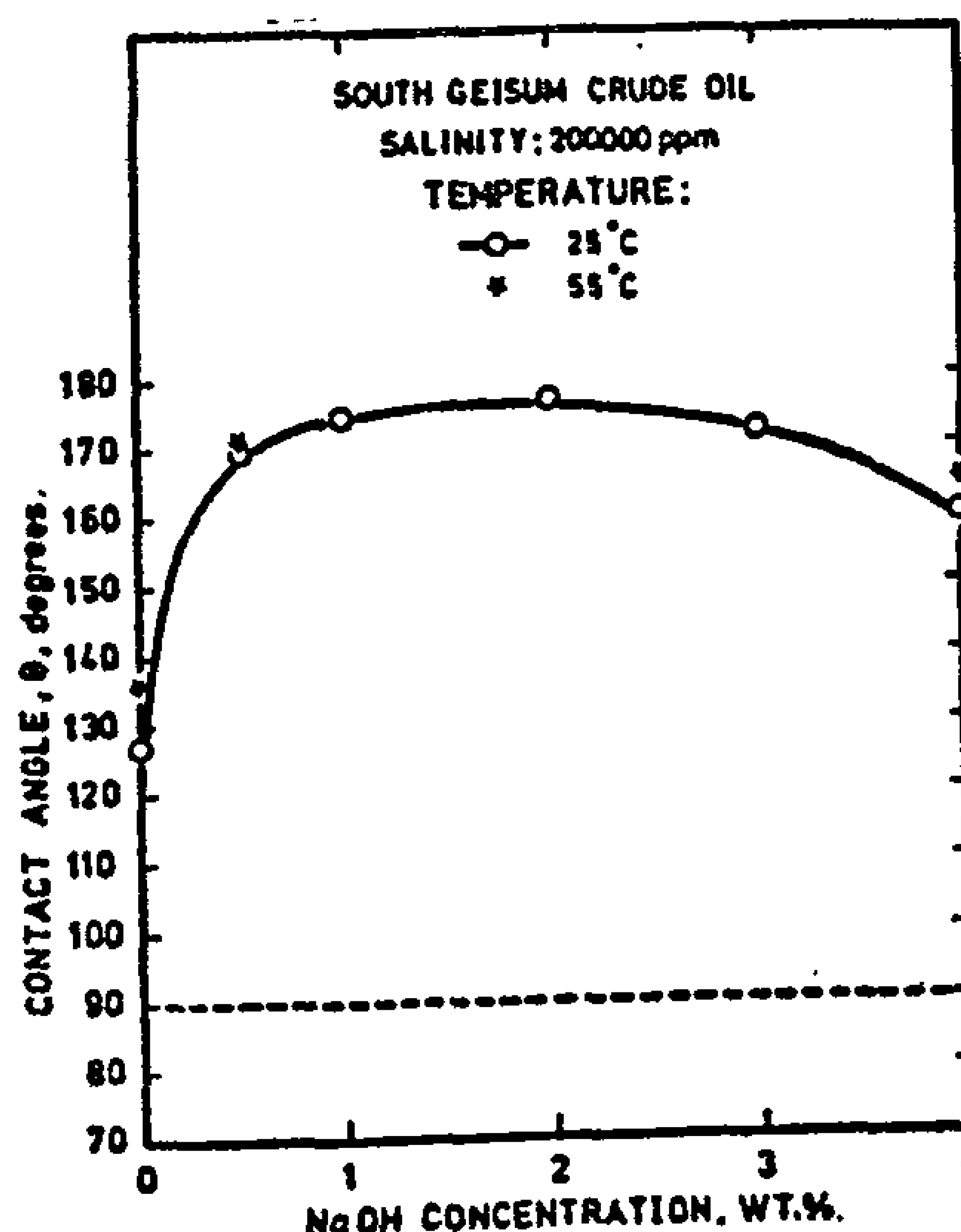


FIG.14 : EFFECT OF TEMPERATURE ON CONTACT ANGLE.

the type of the formed oil-water emulsion. At higher salinities, the formed emulsion could be water-in-oil emulsion which is different from the oil-in-water emulsion in that it needs a higher pressure gradient to move (7), (12). This mechanism can increase the oil recovery only if the interfacial tension is very low. This too low interfacial tension results in a lowering of the capillary forces to a degree enough to let them be overcome by the pressure gradient. But to have this minimum interfacial tension, caustic concentration must be at a favorable level which corresponds to 4% NaOH concentration at 15% PV. This caustic concentration can only be achieved in the porous medium if the concentration reduction rates are adjusted. It is expected that a slug size of 30% PV could increase oil recovery only if the concentration reduction rate is adjusted with the alkaline concentration and the salinity to provide the optimum conditions of the interfacial tension lowering.

Effect of Alkali Type:

In order to compare between the effects of NaOH and Na2 CO3 alkalis on oil recovery and displacement efficiency, two floods were carried out at the same conditions of temperature of 25°C and the same slug size of 15% PV.

Fig. 11 shows the cumulative oil recovery and production histories of these alkaline waterfloods. It is seen from this figure that less oil recovery was obtained in case of using Na2 CO3. The Na2CO3 solution of 4% by weight concentration has a pH value of 9.77 while the pH value of NaOH solution of the same concentration and salinity is 11.35. This difference in PH value may explain the decrease of oil recovery in the case where Na2CO3 is used.

Fig. 12 shows the oil-water interfacial tension versus Na2CO3 concentration. It is clear from this figure that interfacial tension decreases with Na2CO3 concentration. A comparison between the interfacial tension between South Geisum crude oil and both NaOH and Na2CO3 solutions is also shown in this figure. It is clear that the interfacial tension curves are almost the same when using either NaOH or Na2 CO3.

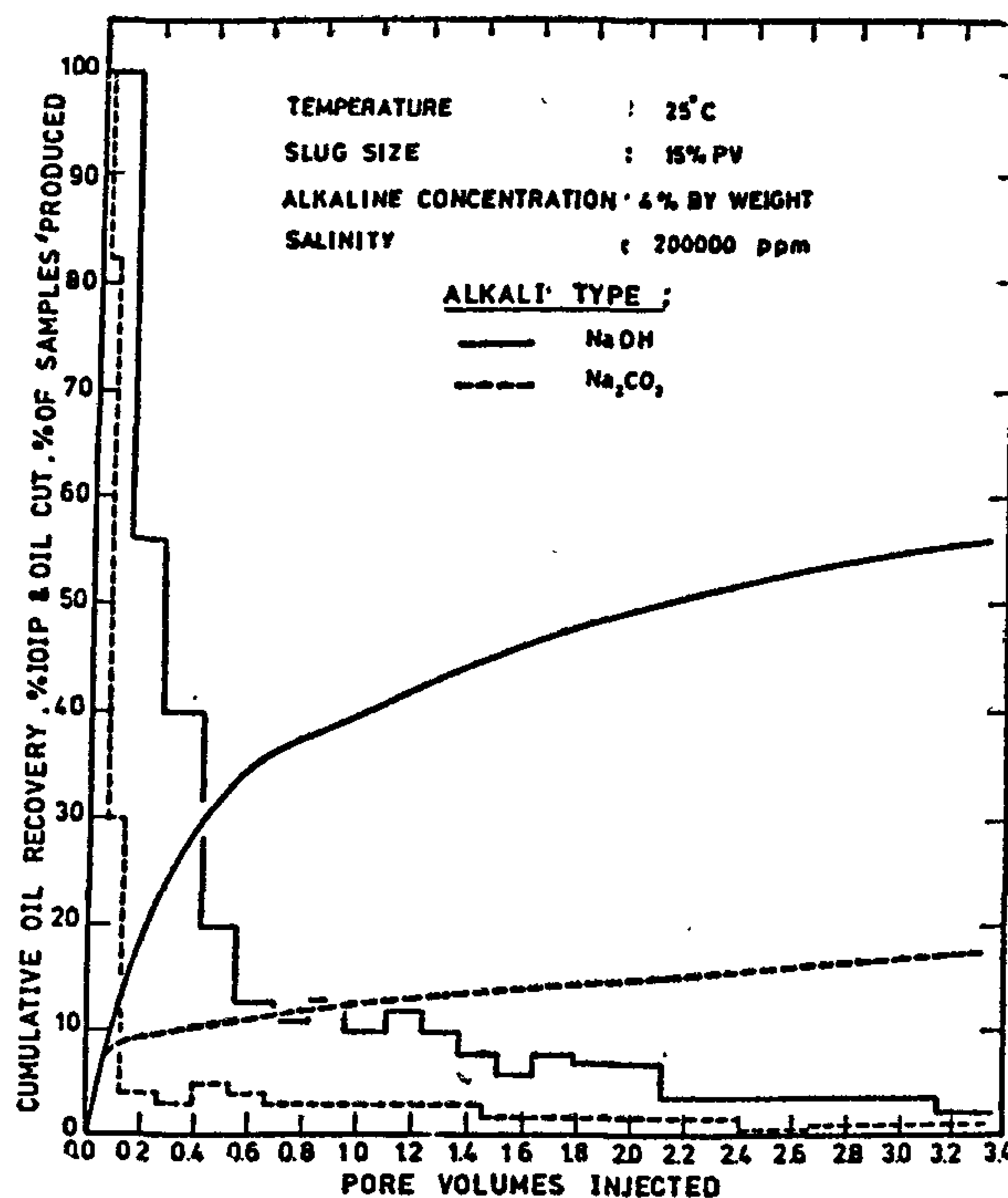


FIG.11 EFFECT OF ALKALI TYPE ON OIL RECOVERY

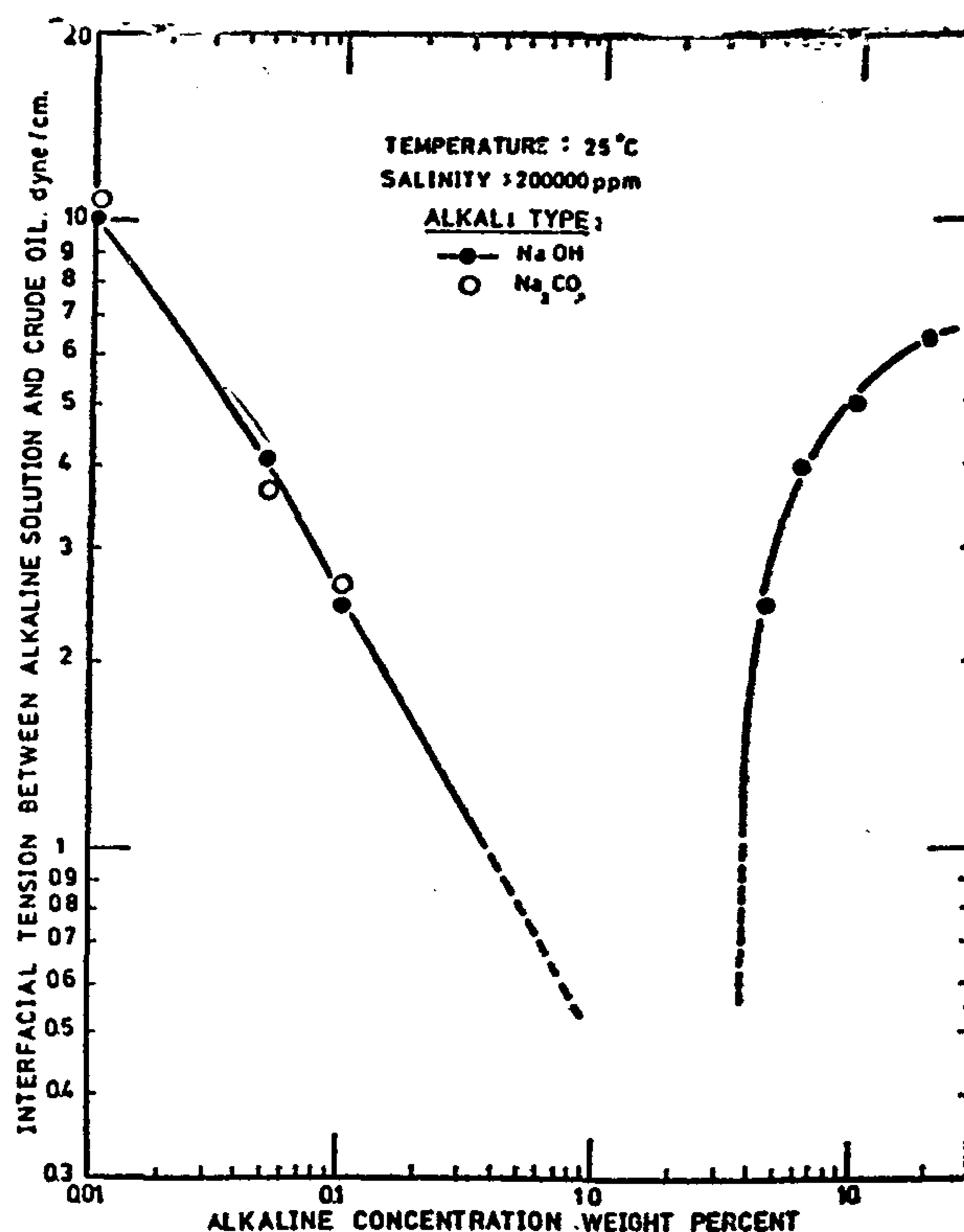


FIG. 12 INTERFACIAL TENSION BETWEEN SOUTH GEISUM CRUDE OIL AND ALKALINE SOLUTIONS (NaOH AND Na_2CO_3) VERSUS ALKALINE CONCENTRATION

The following discussion is an effort to systematically examine the effect of alkaline slug size on the mechanism of displacement of South Geisum crude oil by alkaline slug driven by brine. In general, during the initial time period, only oil is produced. After breakthrough stabilized oil-water bank propagates through the porous medium. Both oil and water at a certain ratio starts at the oil bank breakthrough.

The observed fluctuations in this ratio may be due to either the wetting properties of the rock-fluid system, the interfacial tension between liquids, the viscosity of the liquids, or the composition of the crude oil (acidity). Fig. 8 shows the behavior of the oil-water bank for a varying alkaline slug size with a concentration of 4% by weight NaOH. The distinct feature in this figure is that the oil-water bank was large when using 15% PV slug size and hence more recovery was obtained. It is seen from the production histories that there is a wider bank with 15% PV slug size, compared to that of either 25 or 30% PV slug size.

The increased recovery with increasing slug size up to the optimum slug size of 15% PV can be explained by a better coverage of the displacement by alkaline water. This coverage increases with an increase in the slug size injected. A sufficient slug size is also required to insure production of the alkaline emulsion before it is retrapped again. The problem still arising is a decrease of oil recovery with further increase in slug size. To explain this effect, it is necessary to consider both the alkaline concentration and salinity effects on recovery mechanisms. Reduction of caustic concentration depends on the initial injected slug concentration which was a variable parameter during the examination of the effect of the caustic concentration. The reduction of salinity was neglected because of the constant percent of slug size. In case of using variable slug sizes it is necessary to consider the effect of NaCl concentration change on the displacement process.

Fig. 10 shows the interfacial tension between crude oil and water at two different salinity levels, namely 40,000 and 200.000 ppm NaCl (displacement sea water and slug salinities respectively). It is clear that the interfacial tension decreases with an increase in NaCl concentration.

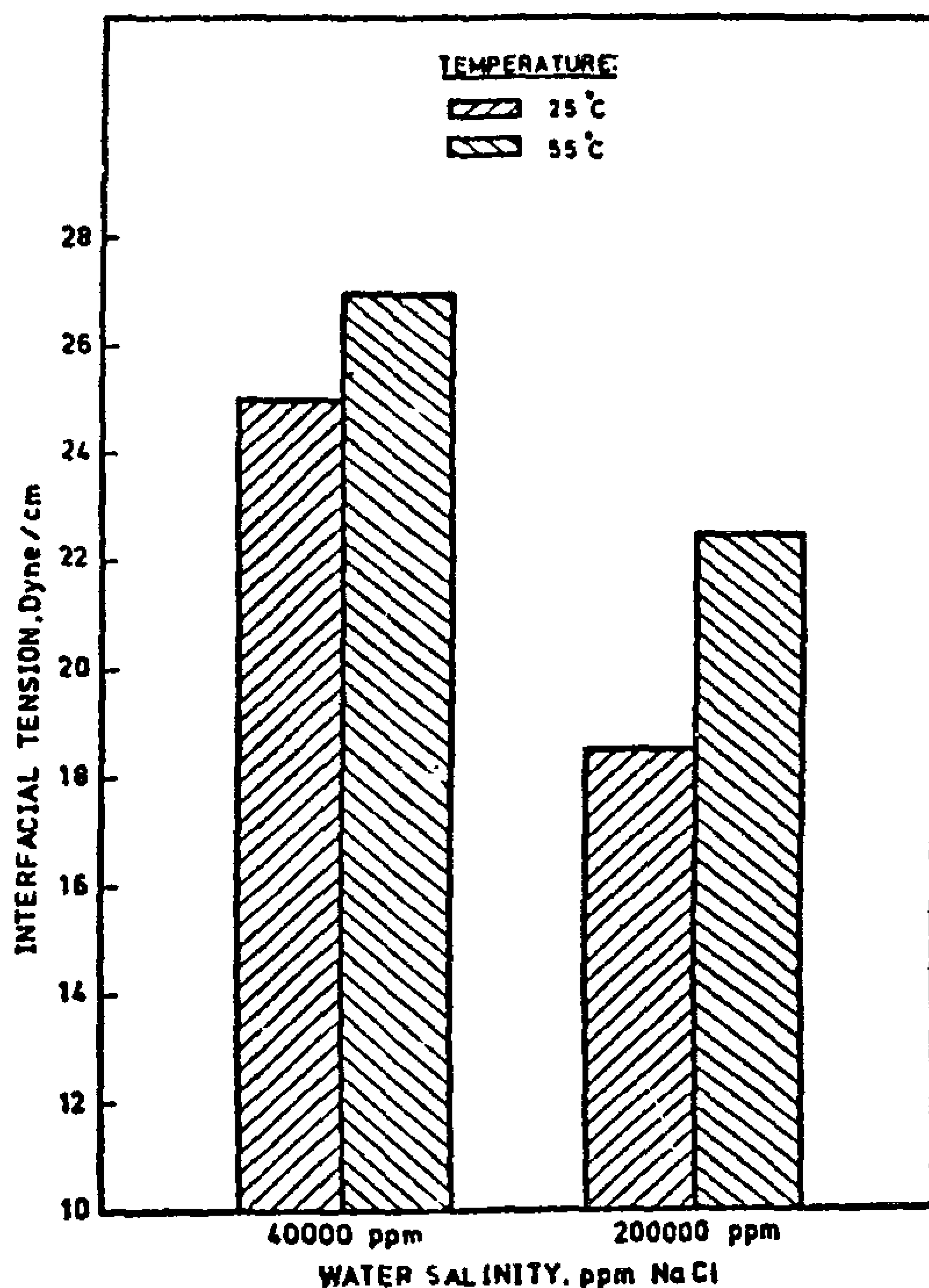


FIG. 10 : INTERFACIAL TENSION BETWEEN SOUTH GEISUM CRUDE OIL AND SEA WATER AND FORMATION WATER.

The salinity effect on both interfacial tension and contact angle can be attributed to its effect on the solubility of the surface active materials resulting from the chemical reaction between alkaline and organic acids in the crude oil. Increasing salinity prevents these surface active materials from being dissolved in the water phase causing it to be adsorbed on either the mineral surface of the rock or the oil water interface, thus enhancing the oil-wetting or decreasing the oil-water interfacial tension respectively. The prevention of the surface active material from dissilution into water also affects

displacement water in the rear of the bank, and to adsorption on the grain surfaces. This reduction in slug concentration leads the slug concentration to be, after some time (depending on the initial concentration), equal to or close to the favorable NaOH concentration which gives the least interfacial tension between oil and alkaline solution and then to produce the oil-water emulsion which will be able to be entrained in the alkaline flow to be produced. This explanation is supported by the presence of the time lags necessary for the production of the oil-water bank at these higher concentration floods. This time lag increases as the difference between the initial injected slug concentration and the favorable NaOH alug concentration increases.

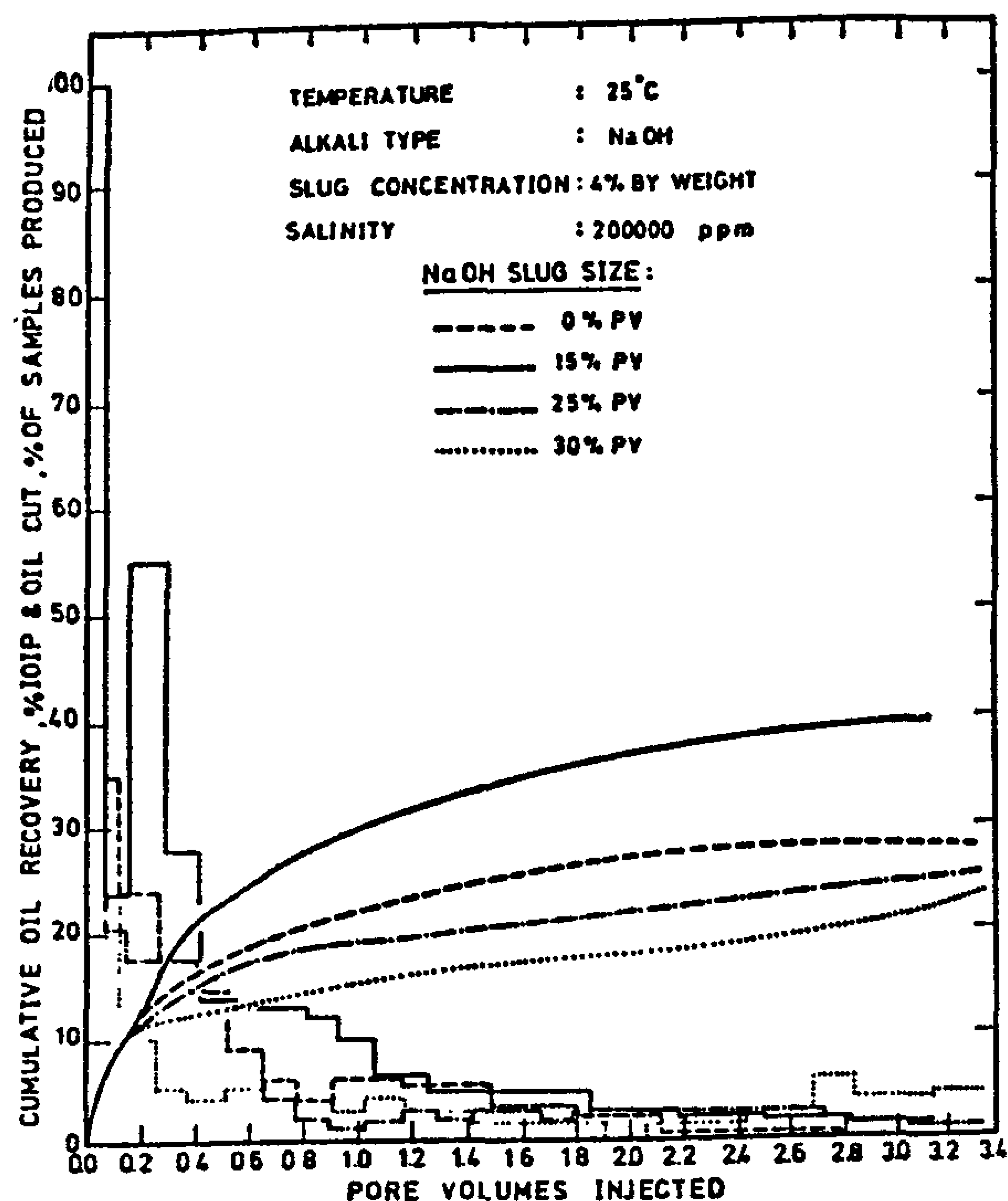


FIG 8 · EFFECT OF ALKALINE SLUG SIZE ON OIL RECOVERY BY ALKALINE WATERFLOOD

Effect of Slug Size:

Fig. 8 shows the production histories for the 0, 15, 25 and 30% pore volumes alkaline slug size displacement at a temperature of 25 C. Cumulative oil recovery is expressed as a percentage of the initial oil in-place. This figure shows the behavior of the oil-water bank for varying alkaline slug size using a 4% by weight NaOH concentration. Fig. 9 is a plot of the oil recovery versus slug size at different pore volume of displacement water injected.

It is evident that South Geisum crude oil recovery increases with an increase in the slug size up to 15% PV, then the oil recovery decreases with further increase in the slug size. This effect was not reported in the literature by previous investigators.

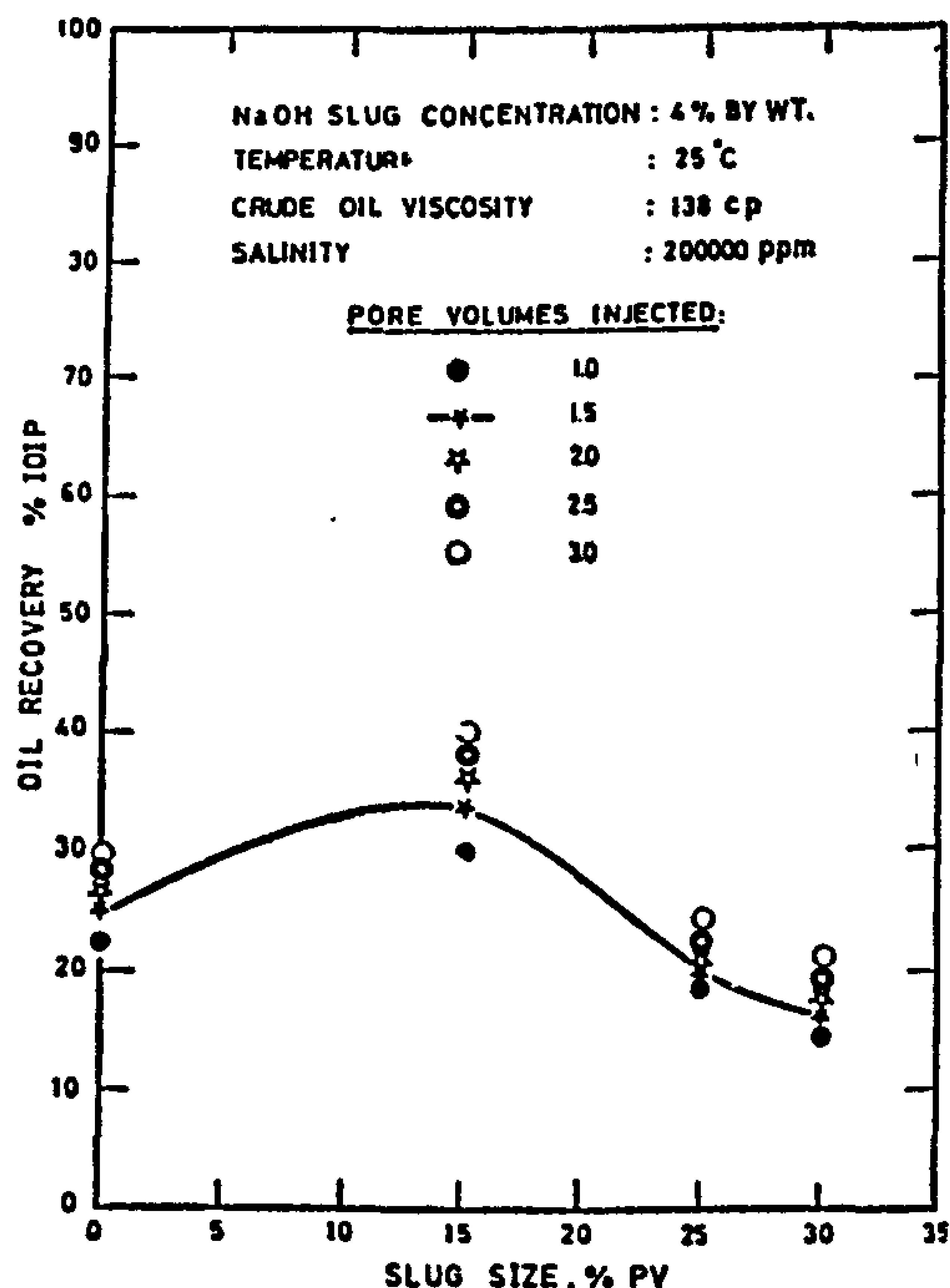


FIG. 9 : EFFECT OF ALKALINE SLUG SIZE ON OIL RECOVERY BY ALKALINE WATERFLOOD AT DIFFERENT PORE VOLUMES OF INJECTED DISPLACEMENT WATER.

Based on Fig. 7 it can be said that the best displacement conditions are in the region of about 3% NaOH concentration. Although this region is characterized by higher contact angle values than the surrounding regions, the excessive decrease of the interfacial tension compensates for the contact angle increase, leading to better displacement conditions. On the contrary, at higher concentrations, contact angle decreases and the interfacial tension increases but by a larger factor yeilding poorer displacement conditions. This result supports the conclusion that interfacial tension lowering is the most effective mechanism for improving displcement efficiency.

From Figs 3 and 4, it is clear that at the early stages of akaline waterflooding, oil recovery increases with increasing NaOH concentration until it reaches a maximum at 4% NaOH concentration. Alkaline concentrations higher than 4% NaOH result in lowering the oil recovery to a level even below that of plain water flooding. On the other hand, although oil recovery during early times for higher NaOH concentrations is low, continuation of displacement by water injection results in the production of an oil-water bank which compensates for the early low oil recovery, and which yeilds a comparable ultimate oil recovery at high and low alkaline slug concentrations. This leads to the conclusion that at large number of pore volumes of water injected, no change in ultimate oil recovery is obtained as a result of varying alkaline slug concentrations. This behaviour is clear from Fig. 4 where, the oil recovery at 2.5 pore volumes injected versus NaOH concentration is almost a horizontal line after 1% NaOH concentration.

For the NaOH slug concentrations tested, the most attractive performance is that in which a 4% by weight NaOH concentration slug is used. This concentration gives the highest oil recovery at the water breakthrough and a large oil-water bank at the lower water-oil ratio which is produced during the early stages.

This result does not correlate directly to the interfacial tension measurements and hence to the adhesion tension results (the best region for the displacement process is at 3% NaOH concentration, Fig. 7) This behavior can be explained by considering the reduction of the concentration of the alkaline slug inside the porous medium due to mixing with connate and displacement water and to the adsorption of alkali on the grain surfaces. This reduction of concentration causes a little shift in the adhesion tension results as compared to displacement results. This shift is dependent on the initial alkaline concentration and on the time of contact with the porous medium. NaOH slugs of concentrations equal to or lower than 4% are expected to lose some of their effective concentration due to adsorption and mixing with connate and displacement water. These concentrations will be still within the range of the adhesion tension values close to zero and this gives favorable oil displacement. This situation is not quite the same in case of higher NaOH concentration slugs which also lose some of their concentration with time but in the direction of the region of better displacement of the adhesion tension close to zero. As shown in Fig. 3 at the early stages of injection, higher concentration displacement floods are characterized by lower oil production than even below those belonging to the conventional waterflooding. After these early injection stages delayed oil-water banks are produced, This early lower production can be attributed to the unfavorable displacement conditions present at these concentrations as a result of the high interfacial tension. The delayed oil-water bank production is due to a dilution of the NaOH slug concentration resulting from mixing with connate water in the front of the bank, and mixing with

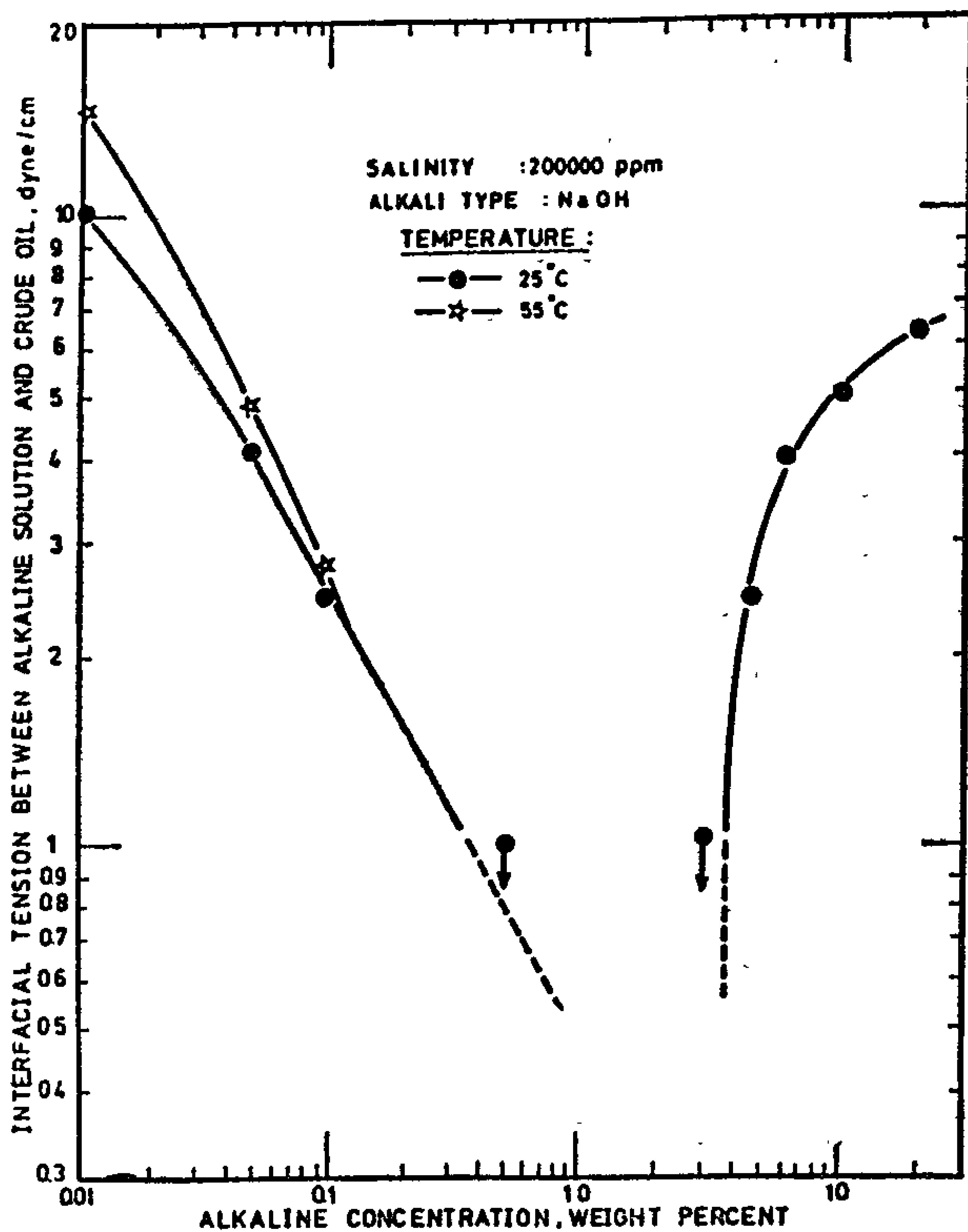


FIG. 5 : INTERFACIAL TENSION BETWEEN SOUTH GEISUM CRUDE OIL AND NaOH SOLUTION AS FUNCTION OF NaOH CONCENTRATION AND TEMPERATURE.

It was also found out from the same figure that the contact angle was affected by the alkaline concentration in such a manner that the presence of 0.5% by weight NaOH resulted in an abrupt increase in the contact angle.. The contact angle increased from 127° to 172° at 0.5% NaOH concentration. Increasing NaOH concentration kept the contact angle at the same high values range (above 170°) until the concentration reached 3% NaOH after which further increase in NaOH concentration resulted in a decrease in the contact angle to 160° at 4% NaOH and to 145° at 10% NaOH concentration.

Adhesion tension ($\sigma_{wo} \cos_{\Theta}$) at different NaOH concentrations was calculated by using both interfacial tension and contact angle. Fig. 7 shows the adhesion tension versus NaOH concentrations.

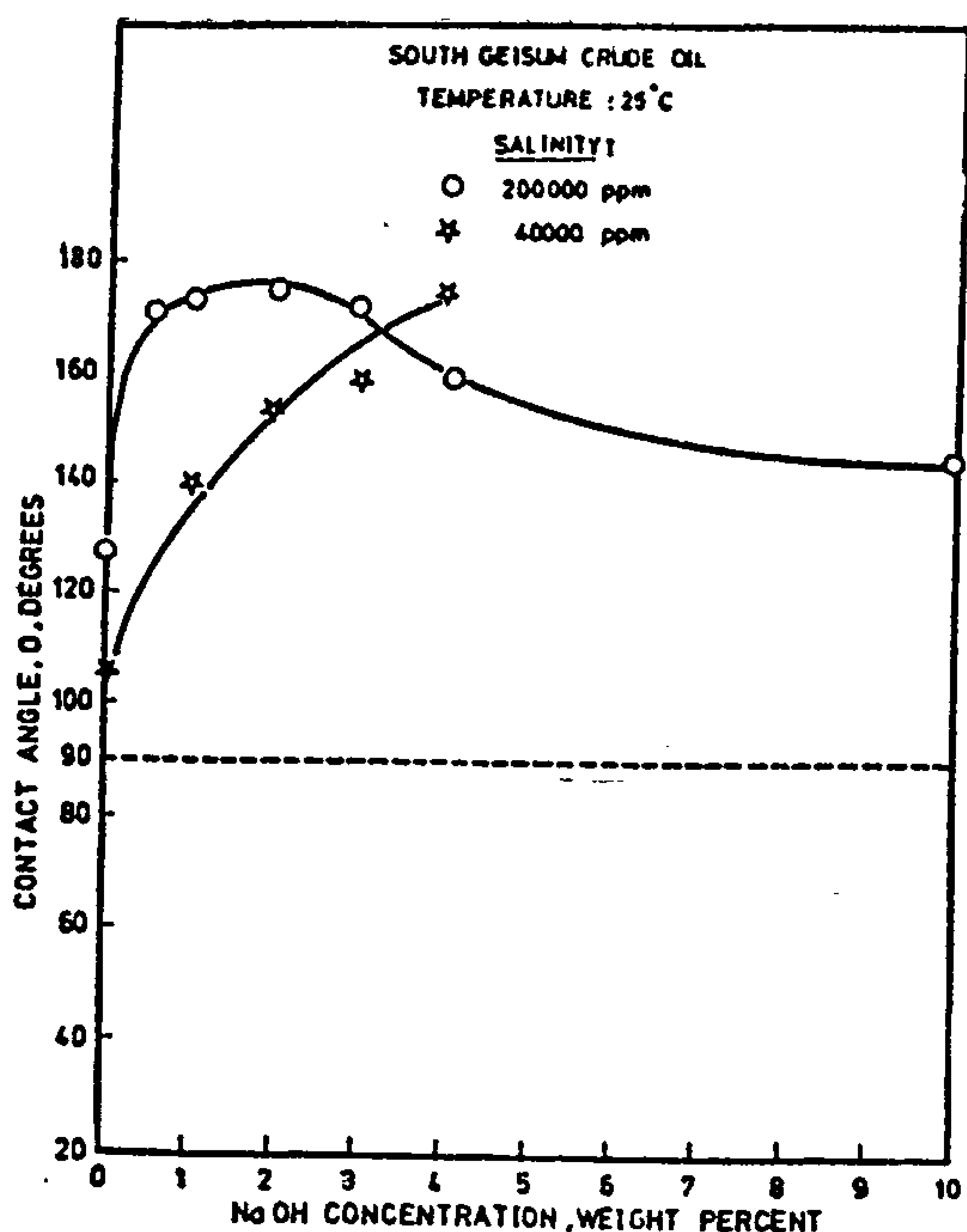


FIG 6 : CONTACT ANGLE AS FUNCTION OF ALKALINE CONCENTRATION AND SALINITY.

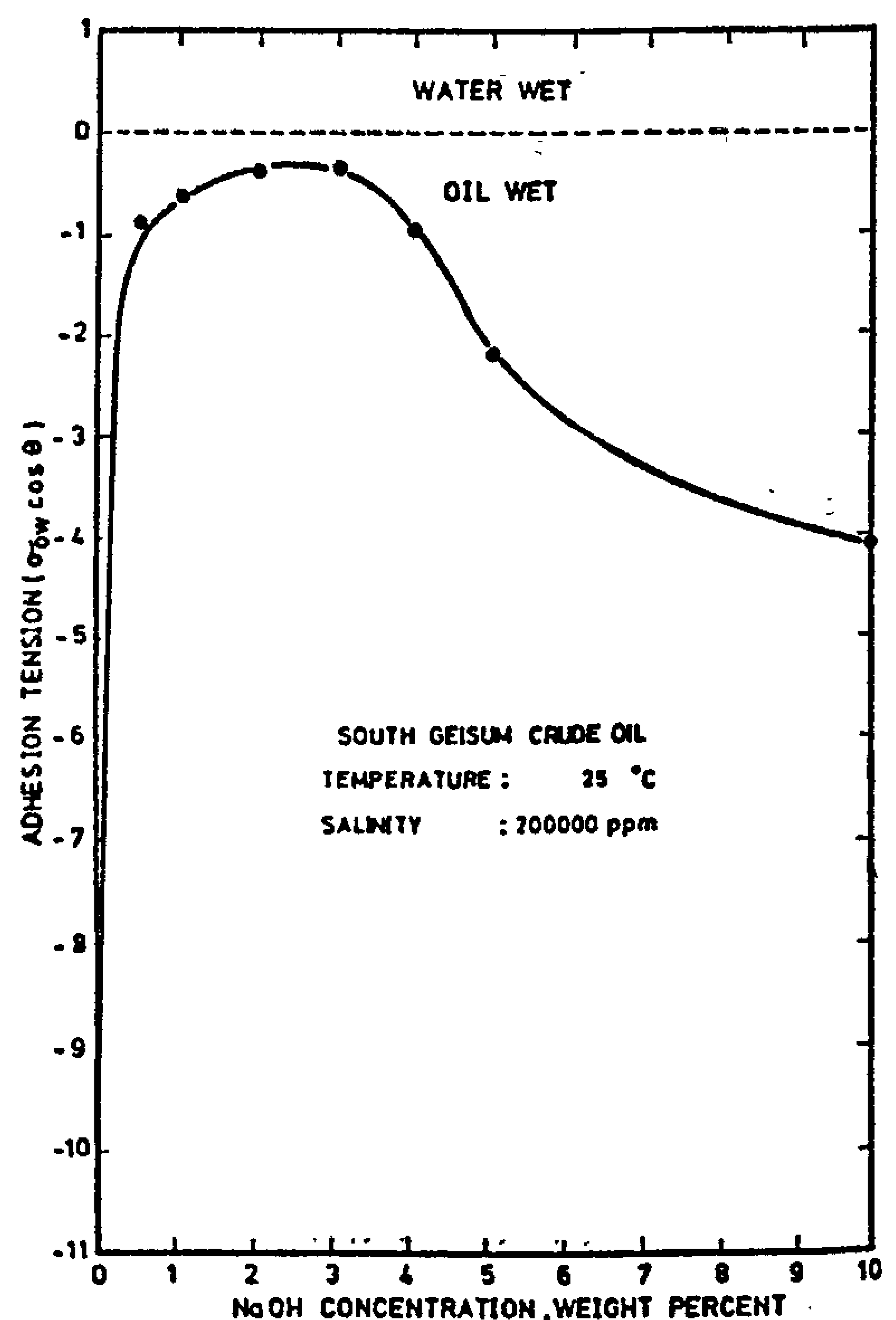


FIG 7 : ADHESION TENSION ($\sigma_{ow} \cos\theta$), VERSUS NaOH CONCENTRATION.

ature of 25° C. The effect of alkaline NaOH concentration on oil recovery at different displacement water pore volumes injected is shown in Fig. 4.

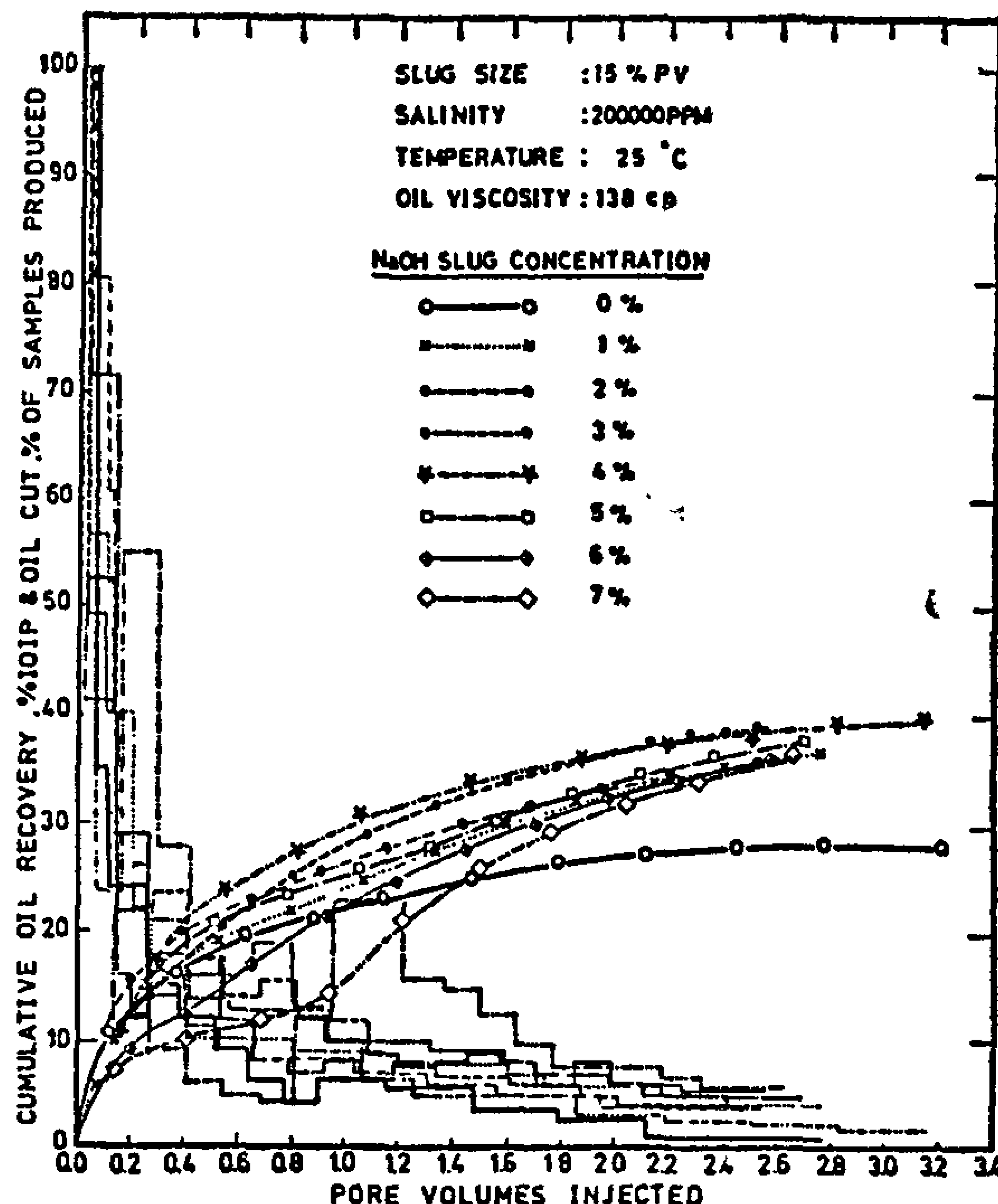


FIG 3 : EFFECT OF NaOH SLUG CONCENTRATION ON OIL RECOVERY BY ALKALINE WATERFLOOD.

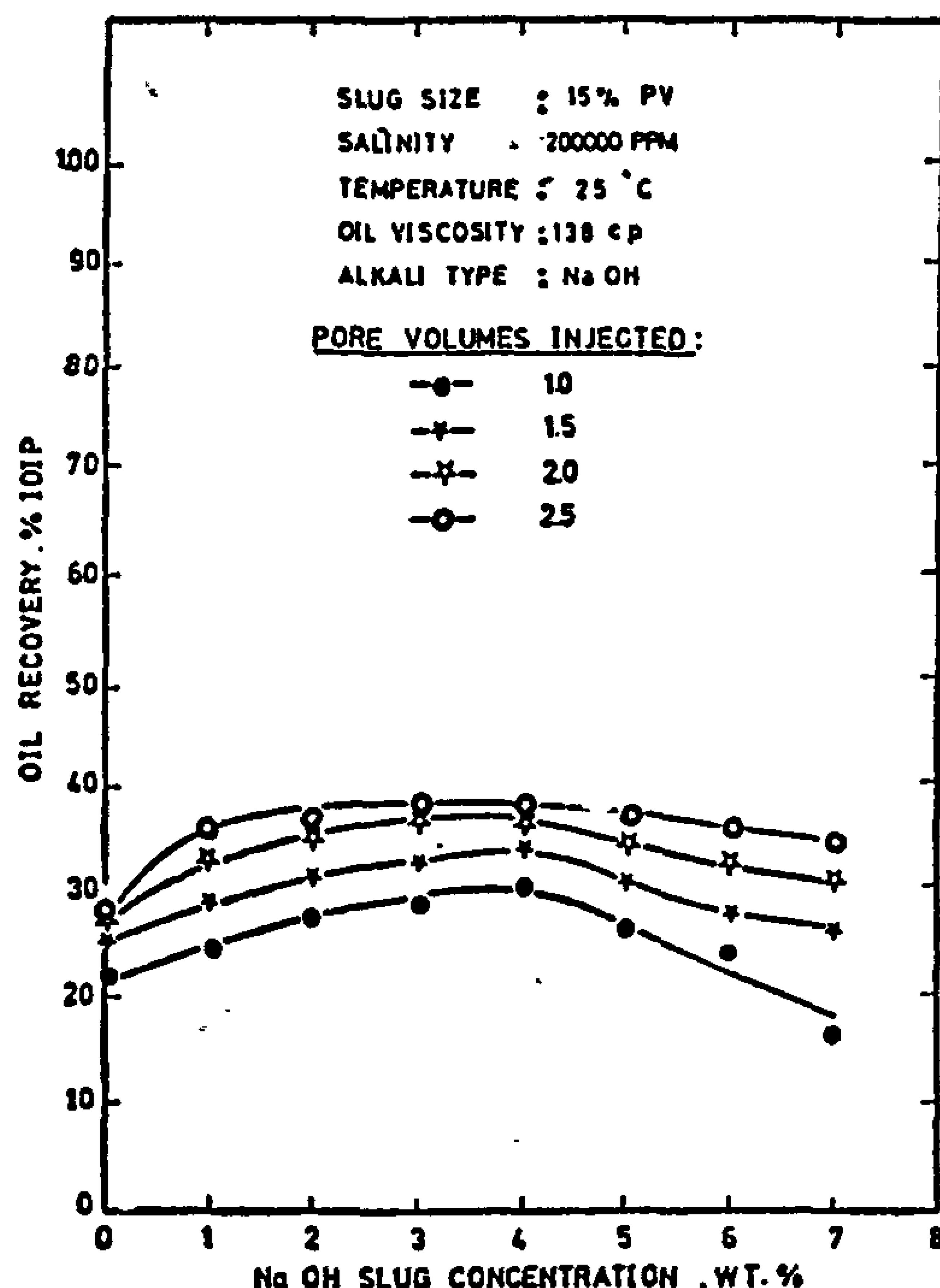


FIG. 4 : EFFECT OF SLUG CONCENTRATION ON OIL RECOVERY, AT DIFFERENT PORE VOLUMES OF INJECTED DISPLACEMENT WATER.

It is seen from these experiments that alkaline waterfloods recover more oil than do conventional waterfloods. This increase in ultimate oil recovery is evidenced by production of a large oil-water bank or by delayed oil production. Since the South Geisum crude oil has a high acid number (4.38 mg KOH/g), the effect of alkali on oil recovery is due to the chemical reactions between alkali ond organic acids occuring in the crude oil. These reactions result in the formation of surface active materials (soaps) whose adsorption on the oil-water interface decreases the interfacial tension between oil and water thus yeilding an oil-water emulsion. This formed emulsion can be entrained into the alkaline flow to be produced, or entrapped again resulting in a better sweep efficiency. The entrainment or entrapment of the formed emulsions depends on the interfacial tension and on the applied pressure gradient during the displacement process.

The effect of alkali (NaOH) on the interfacial tension between crude oil and alkaline solutions is demonstrated by the interfacial tension measurements whose results are shown in Fig. 5 which shows the interfacial tension between South Geisum crude oil and NaOH solutions of 200,000 ppm NaCl salinity versus NaOH concentration at a temperature of 25°C.

It was found out that increasing NaOH concentration decreased the interfacial tension until it reached the least interfacial tension region at 3 to 4% by weight NaOH concentration. Further increase in NaOH concentration resulted in the increase of the interfacial tension again.

Results of contact angle measurements are shown in Fig. 6 using different NaOH solution concentrations in 200,000 and 40,000 ppm NaCl brine at a temperature of 25°C.

of the type Edwards was used to evacuate the model and connections before the start of every experiment. Four stainless steel tanks were used for oil, formation water, displacement water and alkaline slug. An air compressor was used to provide the necessary pressure to inject any of the different liquids into the model. The pressure at the inlet of the model was measured by a pressure gauge. A water bath assembly consisting of a glass basin, electrical heating coil, stirrer and an adjustable thermostat was used to control the temperature.

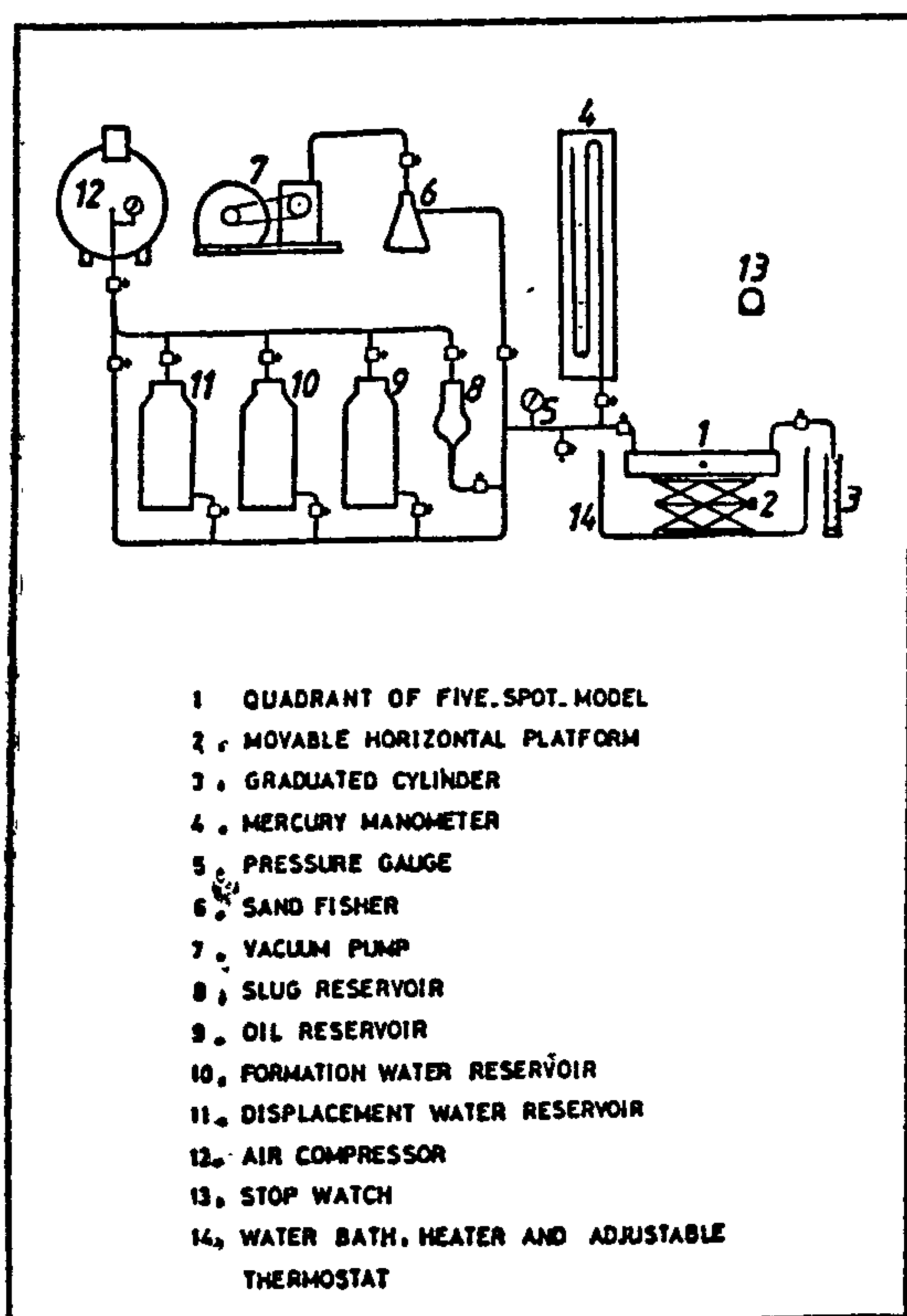


FIG. 2: SCHEMATIC DIAGRAM OF THE DISPLACEMENT APPARATUS.

The model was packed homogeneously with a Maadi Sand mixture. This sand pack had a permeability of about 5.2 darcy. The sand was first thoroughly washed by dilute HC1 solution and again by distilled water. After that it was dried in a drying oven (+ 110°C) to insure the removal of all organic compounds if present. The model was then completely evacuated from air by the use of a vacuum pump. The model was then saturated with water having the same salinity as the field formation water. From the volume of the water used for the saturation process the effective porosity of the sand was calculated. In all sets of displacement experiments, the effective porosity of the sand packs was in the range of 0.34. Absolute permeability was obtained by circulating formation water through the sand pack and measuring the flow rate of water at a certain pressure drop across the sand pack. The model was then saturated with oil by the continuous injection of oil until the water cut in the effluent was less than 1%. At this moment, the initial saturation conditions of the reservoir were supposed to be achieved, and the alkaline slug was injected into the sand pack, followed by displacement sea water continuously for about four pore volumes. The produced liquids were collected continuously and the amount of oil and water in the samlpe were determined and recorded with time.

In this work, the displacement of South Geisum crude oil by alkaline solutions of different concentrations under the same conditions of porosity and permeability was carried out.

All chemical solutions were freshly prepared just before using them to avoid any effect of air exposure or precipitation. All displacement data were the average of at least two runs of good reproducibility.

RESULTS AND DISCUSSION

Effect of Alkaline (NaOH) Concentration on Oil Recovery :

Fig. 3. shows the cumulative oil recovery and oil cut in the produced samples versus pore volumes of water injected using 15% pore volume (PV) slug size of different NaOH concentration at a temper-

Egypt (Fig. 1). The South Geisum oil accumulation in the South Geisum area in the southern portion of the lease is in the Cretaceous and Nubia Sandstone and fractured granite basement and occurs at an average depth of about 5000 feet subsea. The Nubia Sandstone and fractured granite basement directly underlie the Cretaceous Sandstone. The reservoirs are characterized by a relatively high dip angle towards the south, and by heavy faulting.

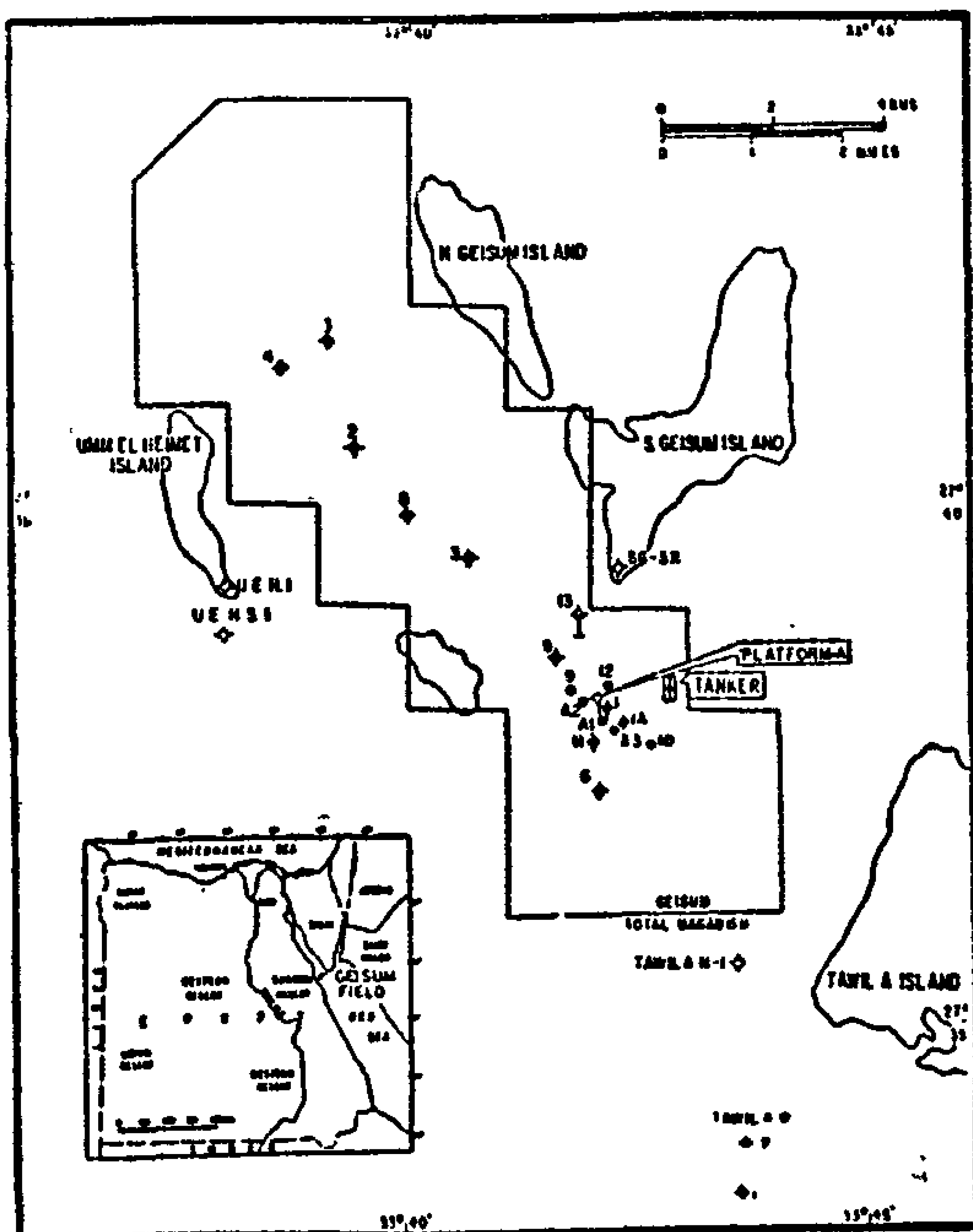


FIG. 1 : LOCATION MAP OF THE GEISUM CONCESSION

South Geisum crude oil is highly acidic, with gravities in the range of 17° -24° API.

Since the main significant characteristic of the crude oil of South Geisum field is its high acidity (4.38 mg KOH/g), this may make Geisum oil field a good candidate for successful enhanced recovery by alkaline waterflooding. Therefore, this investigation was devoted to study the displacement of this crude by alkaline waterflooding and to investigate the effect of the concentration, size, and type of the alkaline sluge as well as the effect of temperature and viscosity on oil recovery efficiency.

EXPERIMENTAL WORK

1. Fluid Properties :

The acidity of Geisum crude oil was determind using the Institute of Petroleum (IP) procedures nos. 1 and 182 [13]. The organic acidity was found to be about 4.38 mg KOH/g sample of crude.

Genco du Nouy tensiometer was used to determine the interfacial tension between oil and water and between oil and alkaline solution. The instrument is equipped with a temperature control system in which water of constant temperature is circulated through a glass cup jacket. Interfacial tension between South Geisum crude oil and both brine and alkaline water was measured at temperature of both 25° and 55° C.

The contact angles that the oil droplet makes with a quartz plate in presence of brine and alkaline solutions at different temperatures were measured. The oil droplet was put in contact with the downward surface of quartz plate under the surface of the formation water or alkaline solution in glass container. The oil droplet was photographed at periodic time intervals (1 hour) to investigate the change of the contact angle with time until equilibrium was reached. By using a slide projector, the dimensions of the drop were measured, and the contact angle (θ) was calculated.

II. Displacement Experiments :

The apparatus used in the displacement experiments is represented schematically in Fig.2. The used model was a quadrant of five-spot model made from perspex which allows visual observation. The inner dimensions of the model were 30x 30x2.5 cm, and it had an injector and a producer on the two ends of the same diagonal. Screens were fixed around the bottom part of the injector and producer to prevent sand movement. A vaccum pump

NEW RESULTS ON THE APPLICATION OF ALKALINE WATERFLOODING TO HIGH ACIDITY CRUDE OIL.

M.H. Sayyouh,* A.A. Abdel-Waly, * A.Z. Awara and A. O. Salama***

Abstract

The main objective of this work was to study the enhanced recovery of a high acidity crude oil (South Geisum crude) by alkaline solutions. Different properties of South Geisum crude oil, namely acidity, interfacial tension, and contact angle were investigated. Displacement tests were carried out to study the effect of alkaline slug concentration, slug size, alkali type, temperature, and viscosity on recovery.

South Geisum crude oil is highly acidic cdude (4.38 mg KOH/g). It was found that the interfacial tension between crude oil and formation water decreases with increasing alkaline concentration until it reaches a minimum, after which it increases again with further increase in alkaline concentration. Interfacial tension between crude oil and displacement water also decreases with increasing alkaline concentration. Contact angle measurements indicated oil-wetting conditions which increase by the addition of alkaline solutions. Displacement floods showed that at the early stages of displacement oil recovery increases with increasing alkaline concentration until it reaches a maximum at 4% by weight NaOH concentration. Also, at such early stages, an excessive increase in alkaline concentration results in lower oil recovery. On the other hand, after the injection of many pore volumes of water, oil recovery is almost the same regardless of the alkaline concentration. It was found also that the oil recovery increases with increasing alkaline slug size until it reaches a maximum at 15% PV after which increasing slug size results in decreasing oil recovery (this result has not as yet been reported in the literature). Sodium hydroxide slugs produce more oil recovery than sodium carbonate slugs. Oil recovery increases with increasing temperature and decreasing oil viscosity.

INTRODUCTION

Displacement of oil by alkaline solutions is an important process [1-12]. Four different mechanisms have already been proposed to explain the displacement process of oil by alkaline solutions. In all these mechanisms, reaction between the alkaline solution and certain organic acids present in some crude oils results in the formation of soaps which enhances emulsification and resulting emulsions either move with the flowing water streem carrying oil droplets with them, or are trapped in pore throats too small to allow their movement, thus, lowering water mobility and increasing vertical and areal sweep efficiency. In all cases, the interfacial tension is lowered by the emulsification process, and under certain conditions, the rock wettability may be altered from oil-wet to water-wet or the reverse. This wettability change results in an increase in oil recovery regardless of the direction of wettability reversal.

The South Geisum field is an off-shore field located at the southern end of the Gulf of Suez adjacent to the Red Sea, offshore

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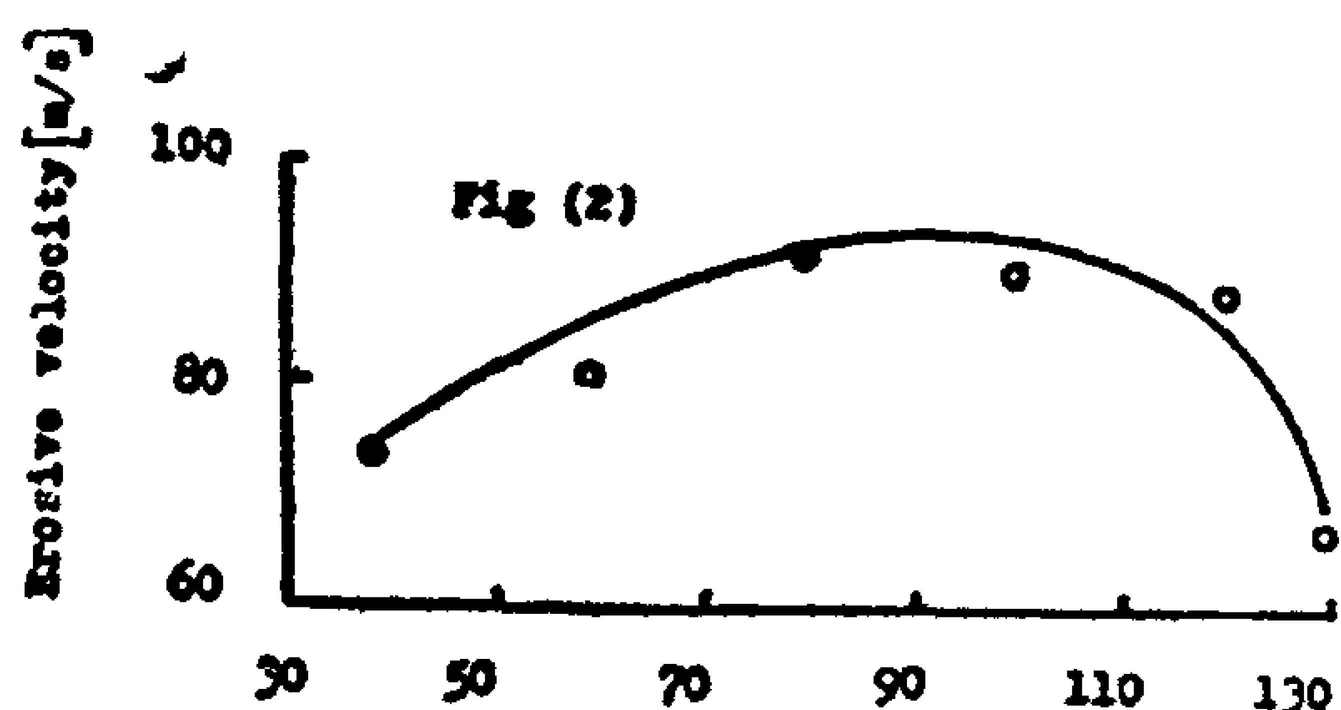
length on the velocity has been examined It is found that the velocity of the particles is dependent on the distance from the nozzle exit measured on its axis and on the length of the nozzle.

Determination of the maximum velocity of the particles is important in the study of the erosive wear of materials and in foundry work.

More work is needed to investigate applicability of the technique at higher velocity of the particle. Also more work is essential to investigate the effect of different parameters such as size, shape, density of the particle, diameter of the nozzle and air pressure on location of maximum velocity of the particles.

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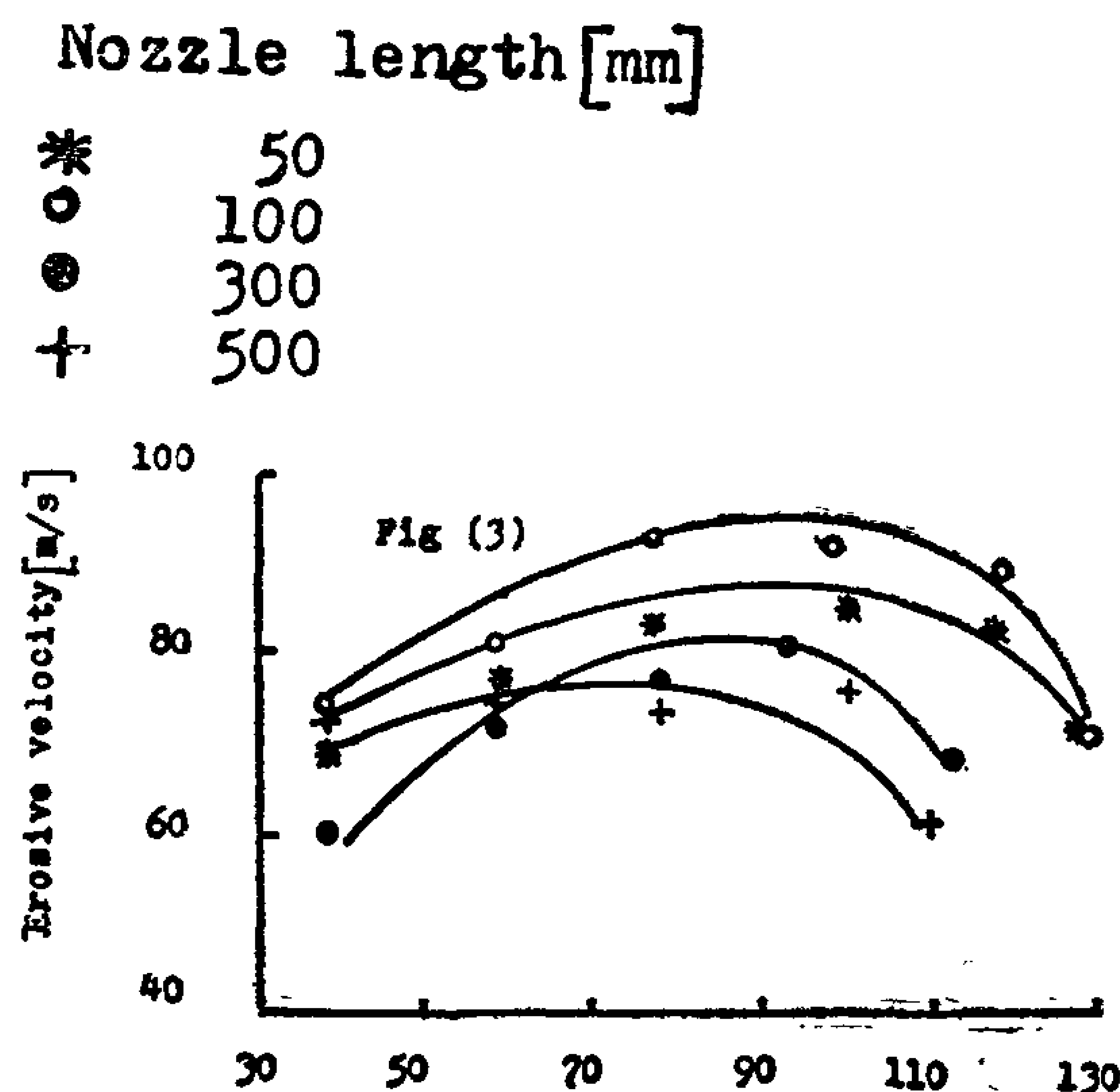
Distance (h) measured from nozzle exit [mm]

Fig. 2 Velocity of erosive particles against distance (h) measured from nozzle exit. Nozzle length and diam. 100 & 8 [mm].

INVESTIGATION OF THE EFFECT OF THE NOZZLE LENGTH ON THE VELOCITY OF THE PARTICLES

Small nozzle length does not allow particles to accelerate enough before exit from it. Long nozzle imposes higher frictional forces on the air flow and consequently on the particles velocity. So, it was decided to examine effect of the nozzle length on the velocity of the particles.

Nozzles of lengthes 50, 100, 300 and 500 [mm] and the same internal diameter, 8 [mm] were used to measure axial velocity of silicon carbide particles. For each nozzle the velocity was determined at different positions along the nozzle axis measured from the nozzle exit. Constant air pressure 500 [kPa] was used in measuring the velocity. Fig. (3) indicates that the nozzle length is not directly proportional to the velocity of the erosive particles. Fig. (4) taken from Fig. (3) is a plot of the maximum velocity obtained at each nozzle length versus the length of the nozzle. The figure also shows that there is an optimum nozzle length to achieve a maximum velocity of the particle. For the present experimental conditions, the optimum nozzle length is 100 [mm] gives a maximum velocity of the erosive particles 93 [m/s].



Distance (h) measured from nozzle exit [mm]

Fig. 3 Velocity of erosive particles against distance (h) measured from nozzle exit for different nozzle lengthes. Nozzles diam. 8 [mm] Air pressure 500 [kPa]

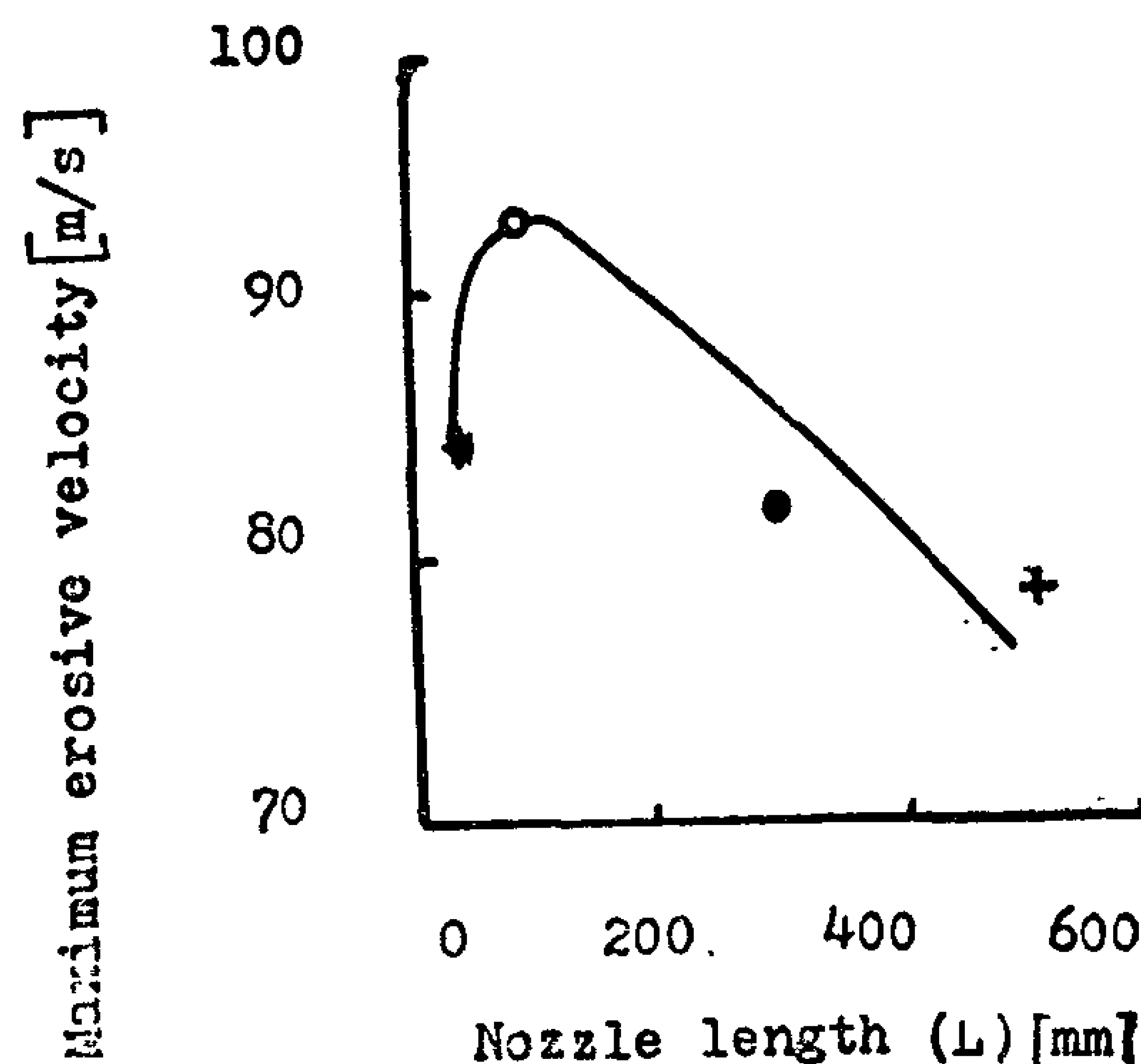


Fig. 4 Maximum erosive velocity obtained from figure (3) against nozzle length L. [mm].

CONCLUSION

A simple and easy method for measuring the velocity of solid particles accelerated by compressed air using the High Speed Camera Technique has been developed.

The effect of the location of the particles with respect to the nozzle exit on the velocity of the erosive particles has been investigated. Also the effect of the nozzle

The measured velocity of the particles is plotted versus the air-pressure of the testing machine as shown in Fig. 1.

Relationship obtained between the velocity V (m/s). and the air-pressure P (kPa) is.

$$V = 2.10 + 0.135\ p$$

Extrapolation of the results shows that the velocity of the particles at zero air-prsesure is 2.1 (m/s) which is approximately equal to the free falling velocity of the particles at the selected section. Results of two other different techniques, measuerd under the same experimental conditions, are plotted on the same figure for comparison. It is seen from the figure that the results of the new technique and the rotating mirror technique are compatible. The results of the double flash method are deviated from the other two techniques at an air-pressure higher than 200 (kPa). This is because in the double flash method it is difficult to identify the new position of each of the moving particles in the photograph.

INVESTIGATION OF THE VELOCITY OF EROSIVE PARTICLES ALONG THE CENTER LINE OF THE NOZZLE

The velocity of the erosive particles along the center line of the nozzle of the air-sand blasting testing machine varies according to position of the particles from the nozzle exit. When the particles exit from the nozzle, its velocity is small. The subsequent expansion of the compressible jet flow into the atomsphere results in an extremum in the jet air velocity at a point downstream of the nozzle exit. Consequently the velocity of the particle will reach its maximum.

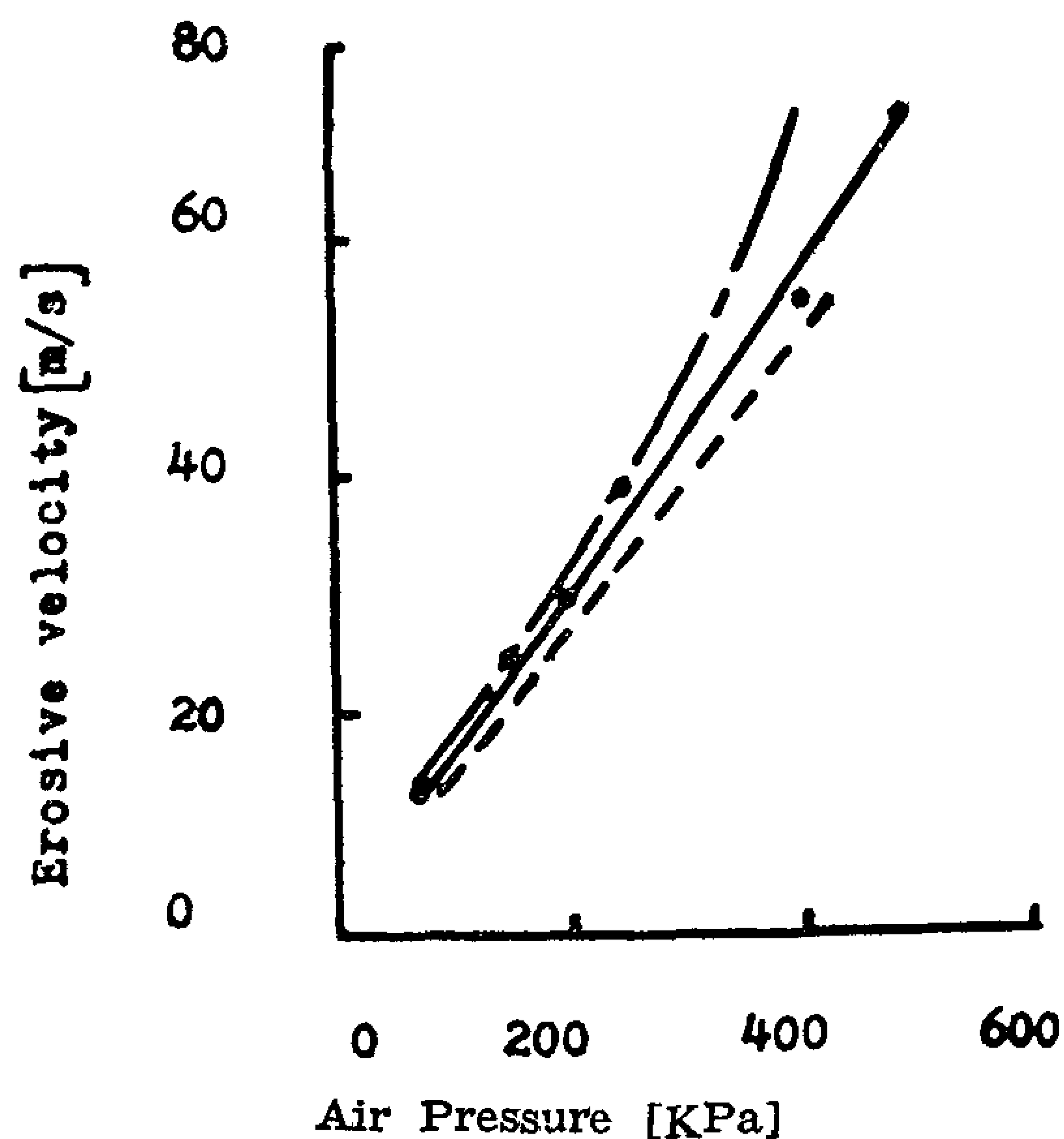


Fig. 1 The velocity of 210 (um) silicon carbide particles measured by high speed camera technique and compared with results obtained from rotating mirror (7) and double flash (9) techniques versus air-pressure. Nozzle length and diameter 100, 8 [mm] respectively.

The velocity of silicon carbide particles was measured at different locations along the nozzle axis. Each location was measured from the nozzle exit along the nozzle axis. The nozzle length and diameter were 100 and 8 (mm) respectively. Air-pressure was 500 (kPa).Fig.(2) shows that the maximum velocity of the particles is reached at a distance of 100 (mm) measured from the exit of the nozzle. The figure indicates also that the maximum velocity is 29% higher than the minimum velocity obtained at a distance 130 (mm) from the nozle exit.

Accuracy of measuring the velocity of some of these methods are poor (8,9,10), while those which have a better accuracy require special instruments (7,11).

The high speed cine-camera and the double flash techniques (8,9) are used for measuring the velocity of the erosive particles. Concept of measurement in both methods is the same. A photograph is taken for the moving particles at two flash shots while the camera shatter is opened. Time between the two flash shots is measured. The mean distance travelled by the particles in the prescribed period of time is measured from the photograph of the particles in two positions during their travel. The average velocity is determined by direct calculations. These techniques impose a serious problem of indentifiying the new positions of moving particles in analysis of the photograph.

Rulf (10) developed a method (the double rotating discs) for determining the velocity of solid particles. Investigation of this method (7) showed that the results obtained are not reliable. Wolak (11) designed a special camera for measuring the velocity of solid particles. Bassili (7) developed an instrument (the rotating mirror instrument) for the same purpose.

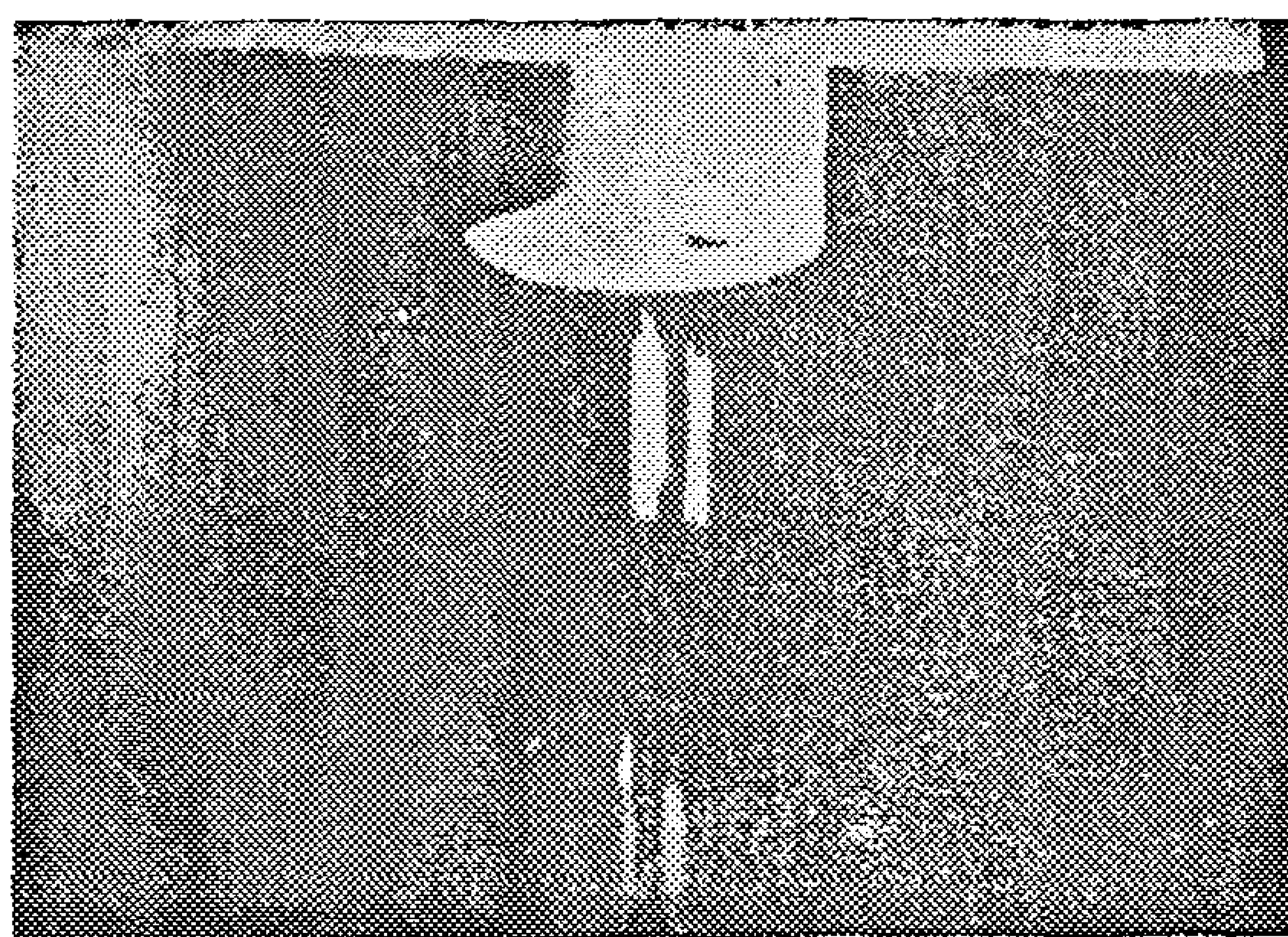
In the present work it is aimed to develop a new technique which is simple, easy to apply with a reliable measuring accuracy.

HIGH SPEED CAMERA TECHNIQUE FOR MEASURING THE VELOCITY OF SOLID PARTICLES

When a moving object is photographed at a low shot speed, the photograph obtained is a successive overlaped images of the object. Each image represents the new position of the object during its motion. The distance between the first and the last image is the distance covered by the object when the camera shutter is opened. The length of this distance depends on the velocity of the object and on the shot speed. This concept has been used in the high speed camera technique

Silicon carbide particles 210 (um) (moving objects) were accelerated in an air-sand blasting testing machine (7) at a small feeding rate 0.05 (g/s). Due to expansion of the compressed air, the accelerated particles were exiting from the nozzle in a conical form. A transverse section of the cone was selected and lightened with a concentrated spot light. A photograph was taken for the lightened section (lightened accelerated particles) at a pre-estimated speed of a high speed camera. Analysis of the photograph showed that the image of moving particles are straight lines as shown in the attached plate. Number of these lines (n) was counted and their lengthes (S) were measured. The travelling time of the particles, shutter opening time. (t) was obtained from the shot speed. The average velocity (V) of the particles was calculated from the simple formula.

$$V = \sum S/nt$$



A photograph of 210 (um) silicon carbide particles accelerated in an air-sand blasting testing machine, camera speed 1000, calculated particles velocity 15 (m/s).

A PHOTOGRAPHIC TECHNIQUE FOR MEASURING THE VELOCITY OF SOLID PARTICLES ACCELERATED BY COMPRESSED AIR

Dr. FARID AZIZ BASSILI*

ABSTRACT

The velocity of erosive particles accelerated by compressed air is an important parameter in evaluating erosive wear of materials and in design of air-sand blasting machines in foundry work.

A simple and fairly accurate technique for measuring the velocity of erosive particles, namely the High Speed Camera Technique, is developed. The technique is used in the determination of the velocity of erosive particles accelerated in an air-sand blasting testing machine. The results are compared with the results of other alternative techniques. The technique is applied to investigate the effects of the nozzle length and the location of the particles from the nozzle exit (measured along the axis of the nozzle) on the velocity of the emerging accelerated particles. It is found that the velocity of the particles increases with increase of its location from the exit of the nozzle and reaches a maximum velocity. The obtained maximum velocity depends on the length of the nozzle.

INTRODUCTION

Erosive wear is defined as the removal of material from the surface of a body by fluid-borne solid particles. The erosive wear is undesirable and represents serious problems in many industrial situations. For instance vehicles which operate in dusty environment such as military heliocopters are developing clouds of solid particles of different sizes (1). These particles attack many components of the vehicle, producing severe erosive wear and dramatically reducing their service life (2).

The quantity of the material lost as wear debris depends on properties of the erosive particles (material, impurities, shape, hardness, velocity and angle of impingement), the eroded material (ductility and hardness) and its temperature.

The velocity of the erosive particles is severely affecting the quantity of the material removed. It is reported that the erosive wear is proportional to the velocity of the particles raised to a power ranging from 2 to 6.5 (3,4,5). Methods of measuring the velocity of particles depend on the machine used in testing the erosive wear of materials. There are two principle classes of those machines. One involves the rotating controlled motion of the specimen in vacuum while the erosive particles drops by gravity (6,7). In this case the relative velocity of the particles is fairly equal to the velocity of the rotating specimen. In the second class of the testing machines, the specimen is fixed while the erosive particles are accelerated by expansion of compressed air (3,7).

Inspite of the importance of the velocity of the particles on the erosion process, few works are found in literature concerning measurements of the velocity of solid particles.

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P = power
P = pressure
Q = heat
T = temperature
η = efficiency ,

Subscripts

b = base load
c = compressor
ex = exhaust
F = fuel
G = gas turbine
H = added from the high temperature reservoir.
i = inlet
is = isentropic
L = rejected to the low temperature reservoir (atmosphere)
m = mechanical
N = net
o = outlet
ov = overall thermal efficiency
p = pump
u = utilized
R = Rankine cycle thermal efficiency
s = steam
st = steam turbine
t = turbine

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Positive linear relationships are found to exist among rated power percentage and the ratio (Q_u/Q_H) with Q_H being the heat added to the system (see fig.7). As may be expected higher outgoing exhaust temperature emerge on the expense of the system performance.

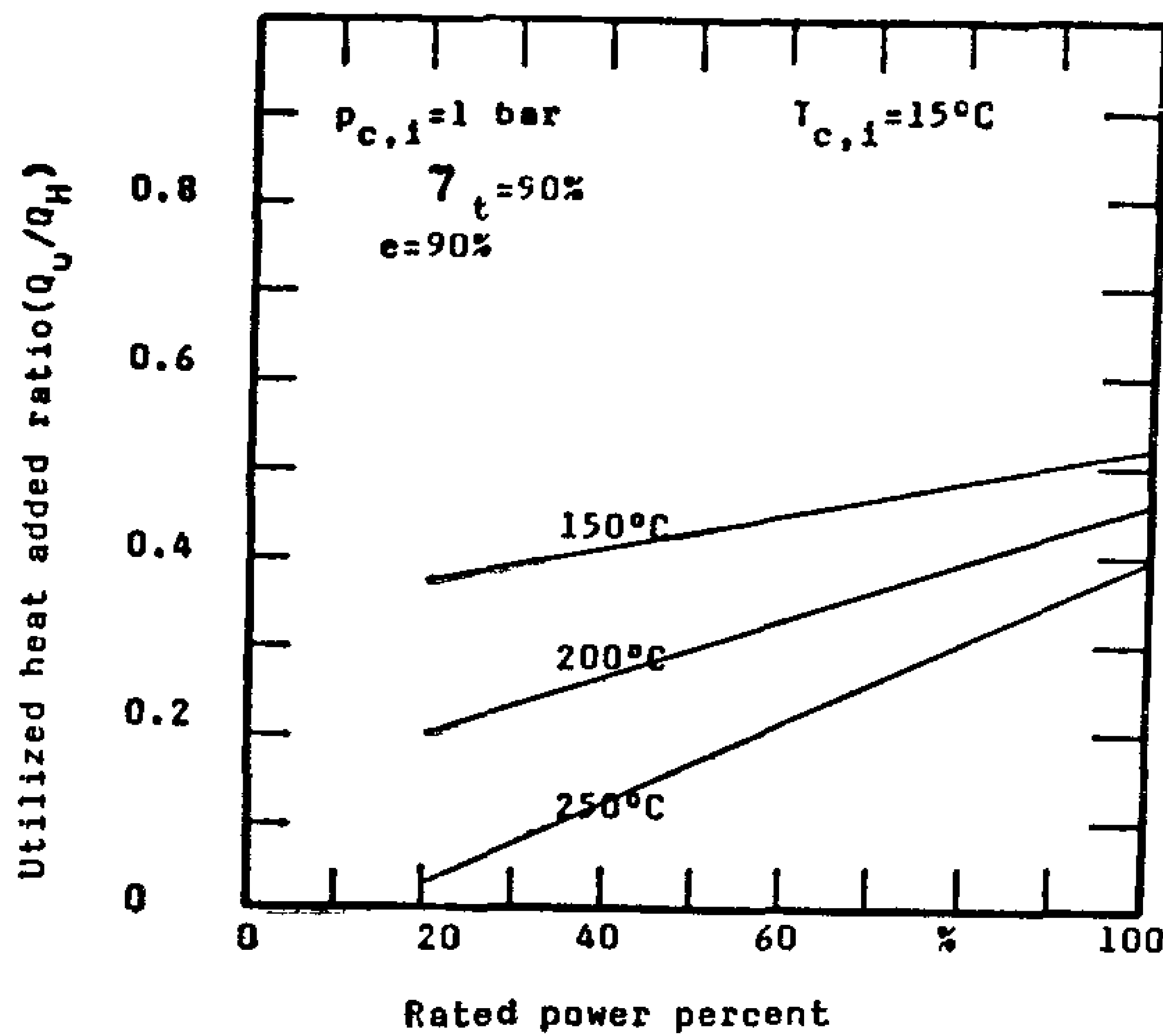


Fig. 7 The effect of rated power on the ratio (Q_u/Q_H)

CONDENSER DESIGN

The condenser uses sea water as a coolant as there is no fresh water source near the plant. The condenser efficiency depends strongly on keeping the sea water side of the tubes relatively free of biofouling. The condenser area can be determined from the simple equation [6];

$$Q = U.A.\ \Delta T_m \qquad (7)$$

Equation (7)can be expressed as;

$$m_s(h_7 - h_8) = U.A.\ \Delta T_m \qquad (8)$$

The overall heat transfer coefficient U of eq. (7) is determined from the sum of the individual thermal resistances due to sea water ($1/h_{sw}$). Fouling or scal on the sea water side ($1/h_f$), The Wall ($1/h_w$). Fouling or scale on the working fluid ($1/h_s$) and the working fluid ($1/h_a$)

$$\frac{1}{U} = \frac{1}{h_{sw}} + \frac{1}{h_f} + \frac{1}{h_w} + \frac{1}{h_s} + \frac{1}{h_a} \qquad (9)$$

The resistance $1/h_F = R_F$ (usually called fouling factor) is largely caused by build-up of biological organisms and can probably limited to the range $R_P \leqslant$ 0.00004 m.. °C/w [7] by suitable cleaning methods. The heat transfer coefficient for sea water (h_{sw}) can usually be determined from the equation [7] ;

$$N_u = \frac{h_{sw}\ .d}{k_w} = 0.058\ R_e^{0.7}\ P_r^{0.5} \qquad (10)$$

CONCLUSION

— A newly introduced arrangement for utilization of the exhaust gas temperature of a gas turbine power plant is given. It proofed to be succesful in raising both of the overall system efficiency from 28% for conventional system to 41%. It also can add 31% more electrical output power at 150°C stack temperature.

— The condenser uses sea water as a coolant. This is suitable for areas with scarce source of fresh water.

— It has been demonstrated that the outgoing exhaust temperature from the waste heat boiler (stack temperature) has a strong effect on the system performance.

NOMENCLATURE

cp	=	specific heat at constant pressure
e	+	effectiveness
h	=	enthalpy
LHV	=	lower calorific heat value.
m	=	mass flow rate

The overall thermal efficiency of the combined gas and steam cycle, is determined by;

$$\eta_{ov} = \frac{P_G + P_{Ns}}{m_F \cdot LHV} \quad (6)$$

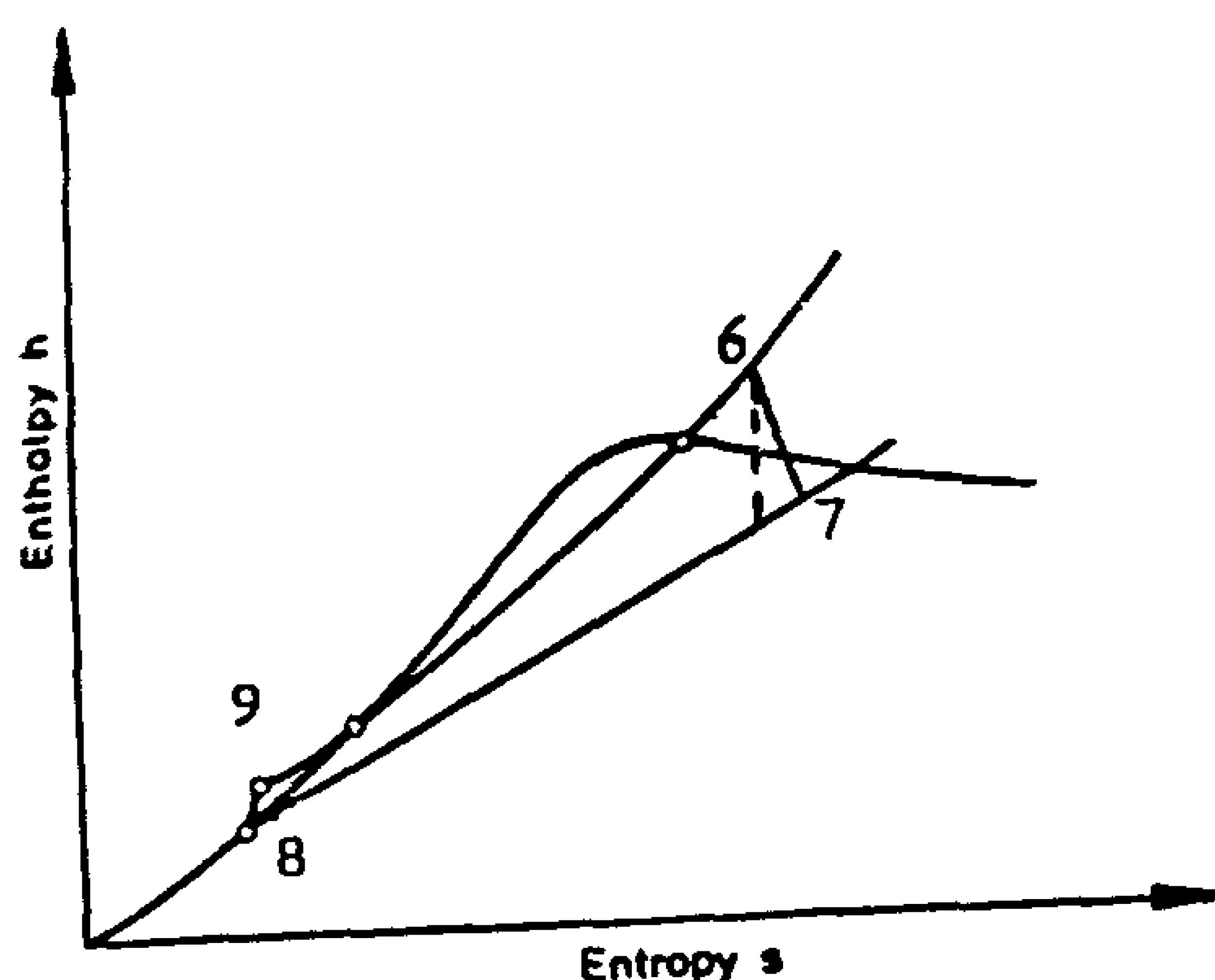


Fig. 3 h,s diagram for Rankine cycle.

Fig. 4 shows the effect of rated power percentage for different exhaust outlet temperatures of the waste heat boiler on both of the effective net power ratio P_{Ns}/P_b and the steam mass flow ratio (m_s/m_{ex}) at a constant turbine efficiency η_t equal to 90%. As the rated power percentage increase so do the effective net power ratio P_{Ns}/P_b and the steam massflow rate ratio (m_b/m_{ex}). It can be revealed that lower gas exhaust temperature outgoing from the waste heat boiler yield better performance as far as the effective net power ratio and steam mass flow rate ratio are concerned.

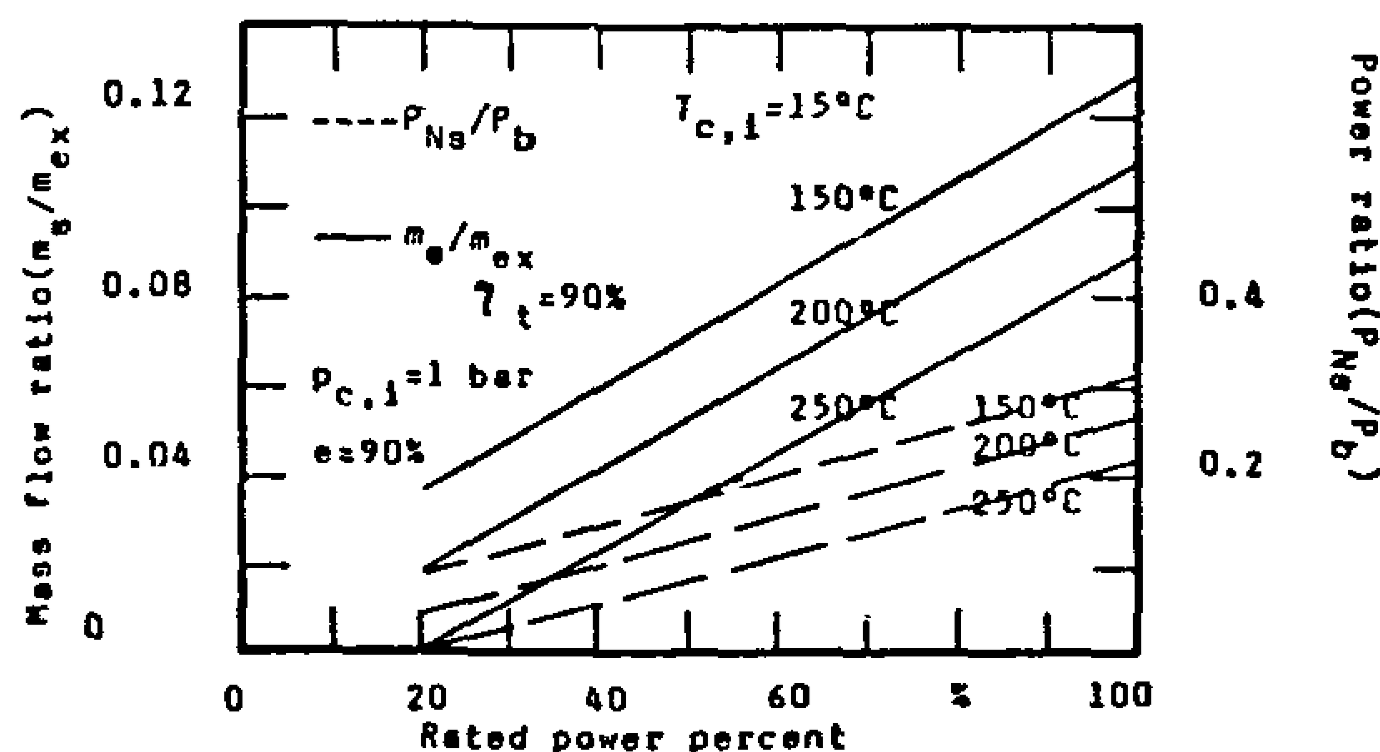


Fig. 4. The relationship among rated power and the ration (m_s/m_{ex}) and (P_{Ns}/P_b)

The variation of thermal efficiency of the conventional gas turbine power plant and the combined gas and steam power plant with the rated power percentage are indicated in fig. 5 .It is evident that, the thermal efficiency at full load for the conventional gas turbine power plant is only 28% whereas that of the proposed system is 41%, for a 150°C stack temperature.

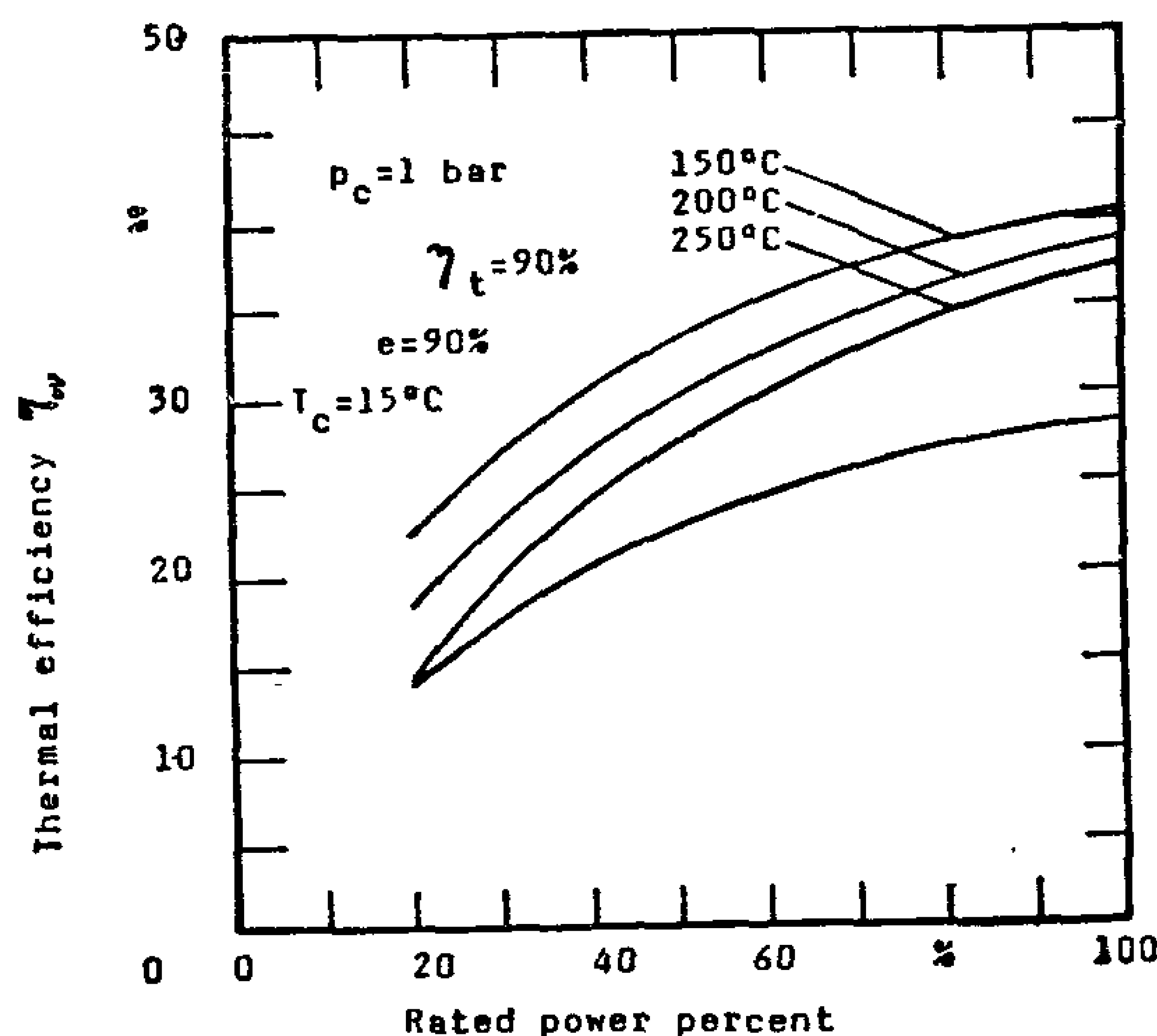


Fig. 5 The effect of rated power on the thermal efficiency

As the rated power percentage increases so do the utilized portion (Q_u/Q_E), see fig. 6. Lower exhaust outlet temperature off the waste heat boiler of offer high performance. This is logical since this means more thermal energy utilization of the exhaust gases leading to reduction in the final outgoing exhaust temperature

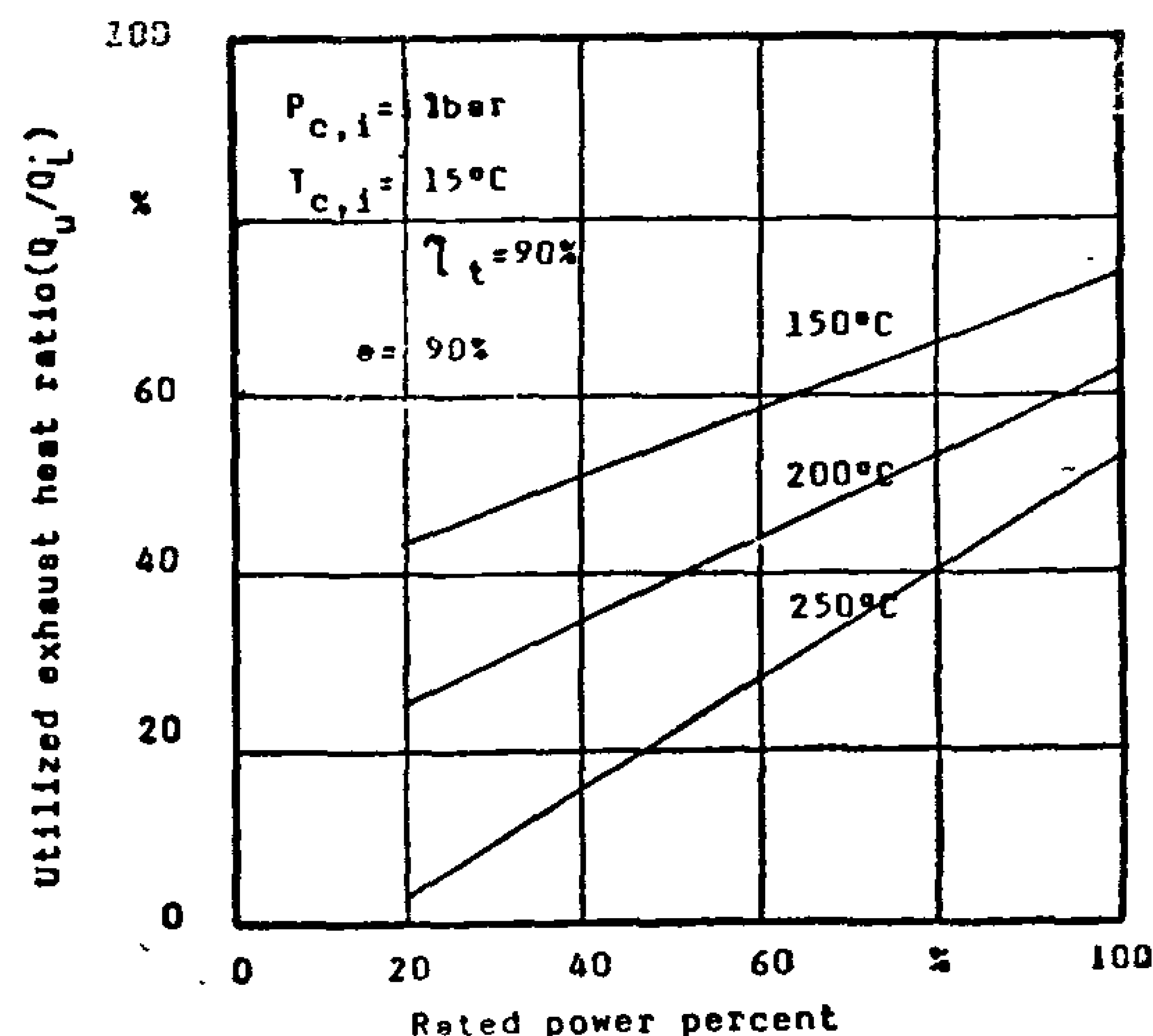
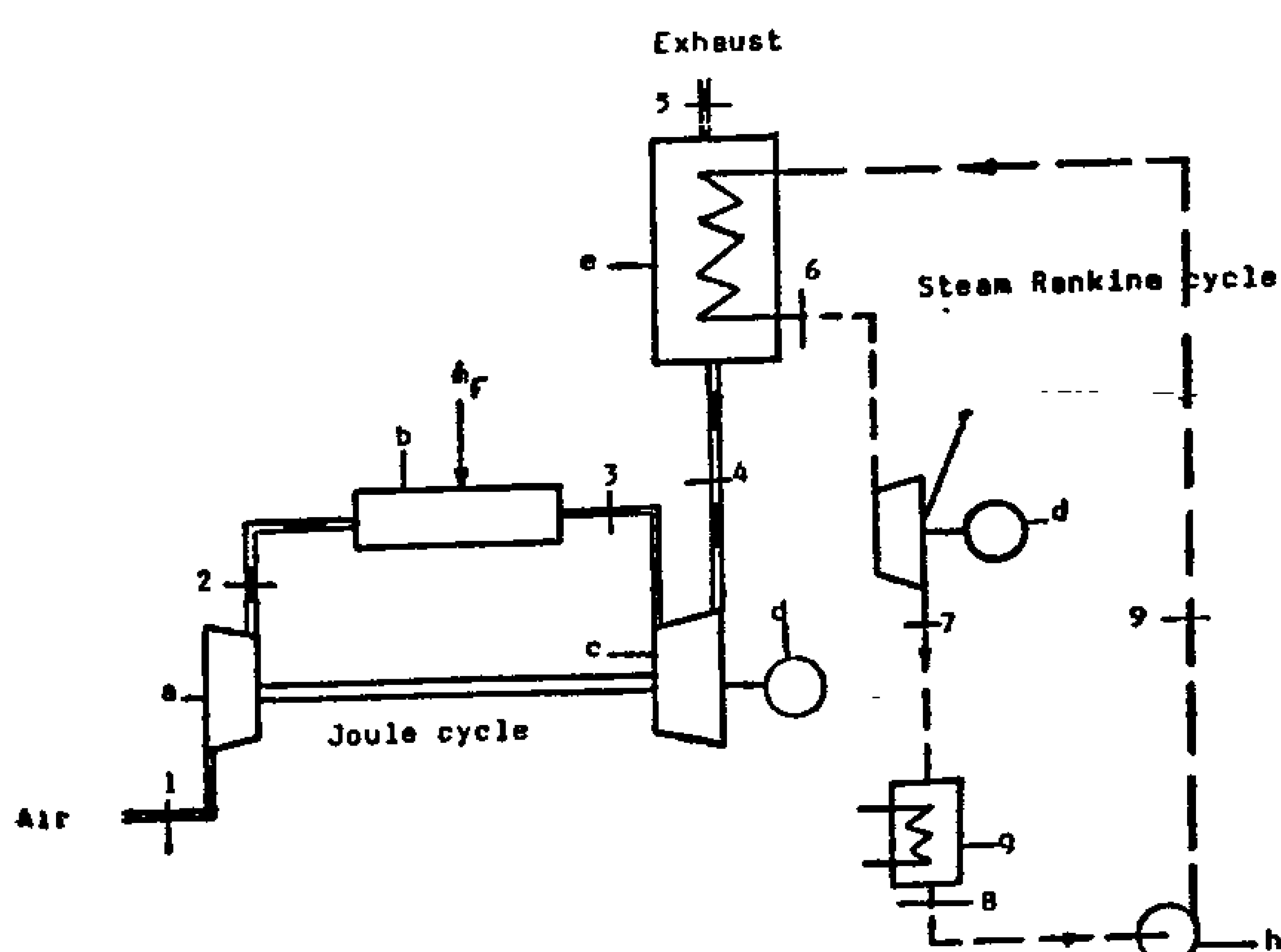


Fig. 6 The effect of rated power on the ratio (Q_u/Q_E)

kine cycle instead of fresh water which is usually not available near the gas turbine power plants.



a = compressor
b = combustion chamber
c = gas turbine
d = generator
e = waste heat boiler
= steam turbine
g = steam condenser
h = steam pump

Fig. 1. Schematic diagram of the gas and steam cycle.

The gas turbine plant operates on a simple Joule cycle shown in fig. 2. The air enters the compressor at point 1 to be compressed adiabatically till point 2. The compressed air enters the combustion chamber. Fuel is added to the air in the combustion chamber to rais the enthalpy of the combustion products to point 3. Such products enters the turbine at point 3. The turbine power is used to run the compressor and to generate electrical power. Exhaust gases (at point 4) having a temperature ranging between 400 to 500°C enters the waste heat boiler (of 90% effectiveness) producing steam at point 6. Waste heat boiler should be adequately designed to prevent corrosion rue to sulpher acids which form at comparatively low temperatures (less than 150°C) [5].

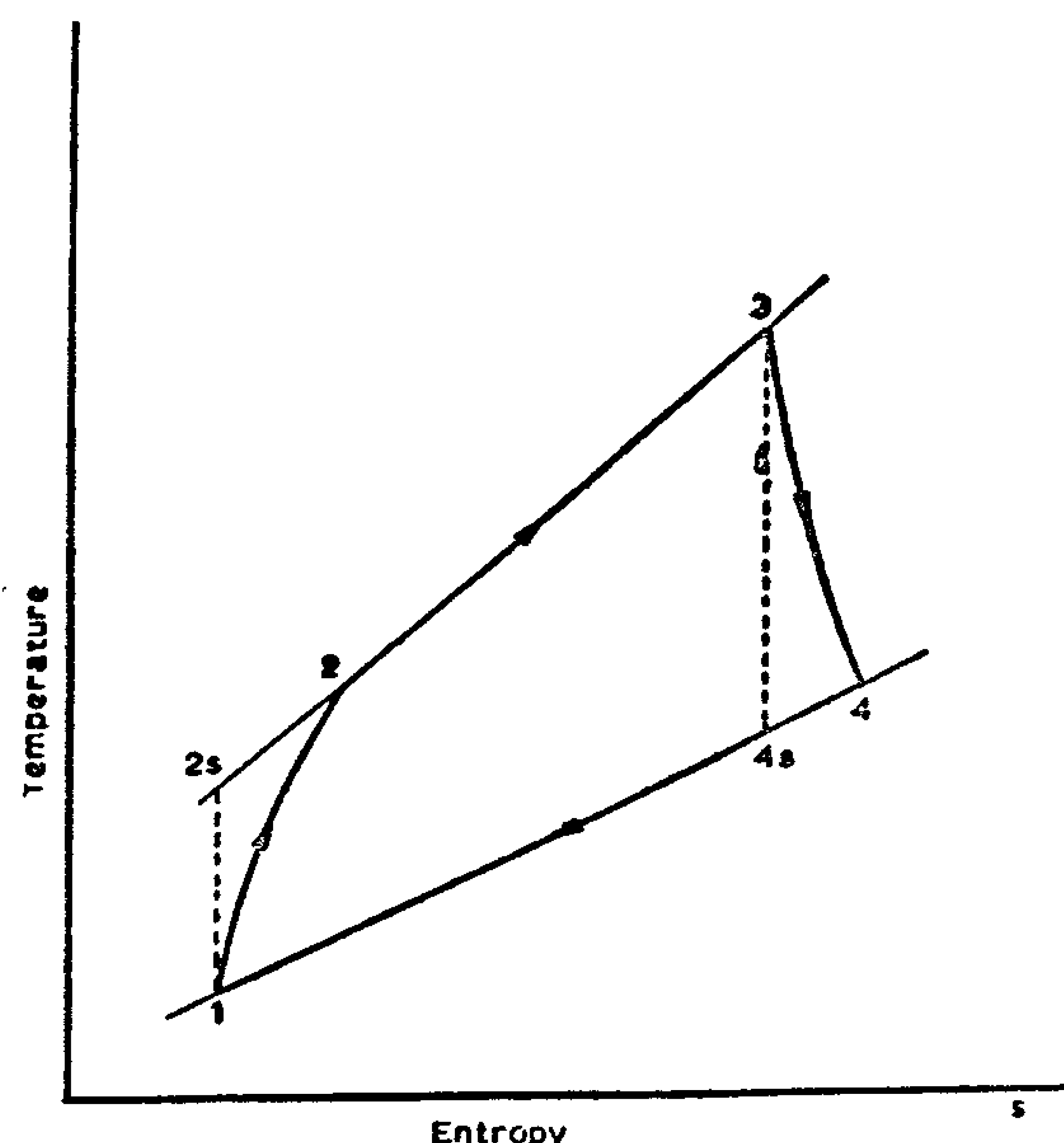


Fig. 2 Simple Joule cycle

In the present research, three values for exhaust outlet temperatures from the waste heat boiler are selected. These three values are (150,200,250°C) chosen to avoid sulpher acid formation.

The steam mass flow rate in this cycle (see fig. 3) is given by;

$$m_s = m_{ex} \cdot e(cp_{ex,i} \cdot T_{ex,i} - cp_{ex,o} \cdot T_{ex,o})/h_6 - h_9 \quad (1)$$

The turbine power can be expressed by;

$$P_{st} = m_s(h_6 - h_{7is}) \; \eta_t \quad (2)$$

The power required to drive the pump is;

$$P_{sp} = m_s(h_9 - h_8)/ \; \eta_m \quad (3)$$

The net power for the steam Rankine cycle is given by;

$$P_{Ns} = P_{st} - P_{sp} \quad (4)$$

The Rankine cycle thermal efficiency is defined as;

$$\eta_R = \frac{P_{Ns}}{m_s(h_6 - h_9)} \quad (5)$$

A COMBINED STEAM CYCLE FOR WASTE HEAT RECOVERY FROM GAS TURBINE POWER PLANT

M. Abdel Kader*

ABSTRACT

Gas and steam turbines can be combined to produce mechanical power in such a way that the combined installation achives a higher efficiency than the gas or steam turbine running alone. A waste heat boiler and steam turbine can be made to follow a gas turbine. The type of fuel used in the combined cycle may be liquid or gaseous. It may be chosen on economical considerations, availability, cost or transportation bases. In the current research, a combined steam cycle is proposed to enhance the performance of a GENERAL ELECTRIC MODEL 341 26, 100 kW gas turbine package power plant which is installed in Port Said (Egypt). Exhaust gases thermal energy is employed, partially, as a heat source for the steam cycle. Utilizing such technique, additional electric station power and better station overallefficiency can be obtained. Variation of the exhaust temperature with the station load has been taken into consideration. From the analysis of the system, the optimum results are found at full load conditions.

INTRODUCTION

The temperature of exhaust gases of a simple gas turbine plant lies between 400 to 500°C. A large quantity of energy (about 70%) is lost with the exhaust gases. Preheating the ingoing air utilizing exhaust gases generally reduce such heat losses to 60%. However, the air preheaters with their large gas & air piping make the plant considerably more expensive and do not increase the power output for a given air flow, but only slightly improve the overall efficiency (1). To recover the heat energy of the exhaust gases, a steam plant can be coupled with the gas turbine installation (2). This combined cycle recover much of the exhaust energy by passing the high temperature exhaust gases through a waste heat boiler to generate steam which can be further utilized to drive a steam turbine. The combined cycle increases both of the output power and overall efficiency(3). The problem in using the combined cycle is that ample water source must be available to provide the condenser with water for cooling. And this is not available in all situations. To avoid this problem, in the present work sea water is used as a coolant for the steam condenser.

SYSTEM ANALYSIS

Normally, exhaust gases off gas turbine power plants are wasted at elevated temperatures causing significant heat loss. Therefore, the use of gas turbine plants in electric power stations without any heat recuperating apparatus makes them uneconomical (4). In the present investigation, exhaust gases supply the heat require to produce steam in a waste heat boiler shown in fig. 1. From fig. 1 it can be seen that a steam cycle is combined with the gas turbine power plant. Sea water is used as a coolant for the condenser in the Ran-

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This can be due to too short time of testing rather than due to escape of the residues of additive which, together, suggest the change of testing conditions at elevated temperatures in NA towards longer times in order to verify the tendency found.

The aim of further studies is to carry on test also with full size sample although the method proposed can significantly shortened duration of separate tests, thus is very tempting.

It has to be also noted that, according to many opinions, prolonged tests at constant level are less convinient and give large scatter of results which do not allow a meaningful discussion.

Nevertheless, the testing of treeing endurance of dielectric materials and insulations requires further development and the concept using samples of high degree of repeatability and purity during cut-off test can be one of the solutions.

It can be concluded that the both arrangements proposed can compare qualitatively different polyethylene materials. They can display different ability of the same material to withstand breakdown caused by different degradation process.

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The effect of crosslinking is noticable, however, the additive seems to cause little difference in life of samples in comparison with unsaturated ones.

4. Discussion and conclusions.

There is well known fact that the degradation of plastic materials under ac stresses can be very intensive when initiated at localised points by concentrated, highly divergent field.

Such field concentration appeared in both arrangement used : in SA, at the vicinity of a void and in NA, at the tip of a needle electrode. Thus, pre-breakdown channels could be developed in SA of interfacial and in NA of volume type.

It must be noted that the working stresses during tsts were relatively high (from 10 kv/mm in NA to 25 kv/mm in SA) which caused relatively short life of samples in both arrangemens. However, as it was indicated in the past/5,8, 14/even under such stressing the conditions of acceleration of the breakdown process can still serve comparative purposes.

Unfortunately there are no data of other authors to be comparable with those presented for SA.

It is visible that at 20°C there is no indication that either crosslinking or saturation make any influence on the life of samples. It can be suggested that the time to breakdown is generally governed by surface properties of samples, in particular by their roughness which is comparable for all samples tested. It is also clear that the confidence intervals (not marked on the Weibull distributions of results) show tendency to overlapping, thus no satistically meaningfull differences can be stated.

At elevated temperature the effect of higher thermal stability of XLPE can operate as well as the effect of migration of additive, reported also in /11/. It is accepted that this effect is not permanent but decreasing with time/16/. However, it requires much longer times and width the periods of single hours and at the operating stresses the residue of additive can exude to the surfaces to create a field-dependent electrical conductivity which tends to reduce the critical stress for onset of final breakdown path from the surface into the material.

The most of work on testing of the resistance of polyethylene to degradation have been done with different needle systems. /3/. However, the arrangement with a single needle in normally used for testing of the resistance against initiation of treeing during short time stressing increased in steps.

For testing of the resistance to electrical breakdown by treeing using divergent fields a double-electrode system have been proposed /17/. Nevertheless, the author's experience shows that single-needle arrangements can much easier fullfil the all requirements of reproducibility of samples and, moreover, can also be a reliable diagnostic tool.

The results in NA show that, at normal temperatures, cross-linking and saturation by additive improve the resistance to breakdown by treeing. This confirm the other data reported by some authors /9, 10 11/.

It can be summarised that the influence of additives is due to : higher permittivity (decreasing of the field around the tip), apparent enlarging of the radius of curvature of the tip (Faraday cage effect absorbing energy of hot electrons (filling of the channels) and improving of mechanical stress distribution.

However, at higher temperature the effect of crosslinking remains while the ef- of additive disappears.

3. Results

The method of testing adopted used constant electric stress continued until electrical breakdown of 7 specimens occured. The test results were produced by means of Weibull plots and statistical criteria of testing (scale parameter η and shape parameter β) could be evaluated. However, the scale parameter at the breakdown probability level 63 % was replaced for comparative purposes by the parameter η' evaluated at 20% probabiliyt level. The plots were obtained graphically (squares method).

Results of tests carried out at normal temperature are shown in Fig. 2 and 3.

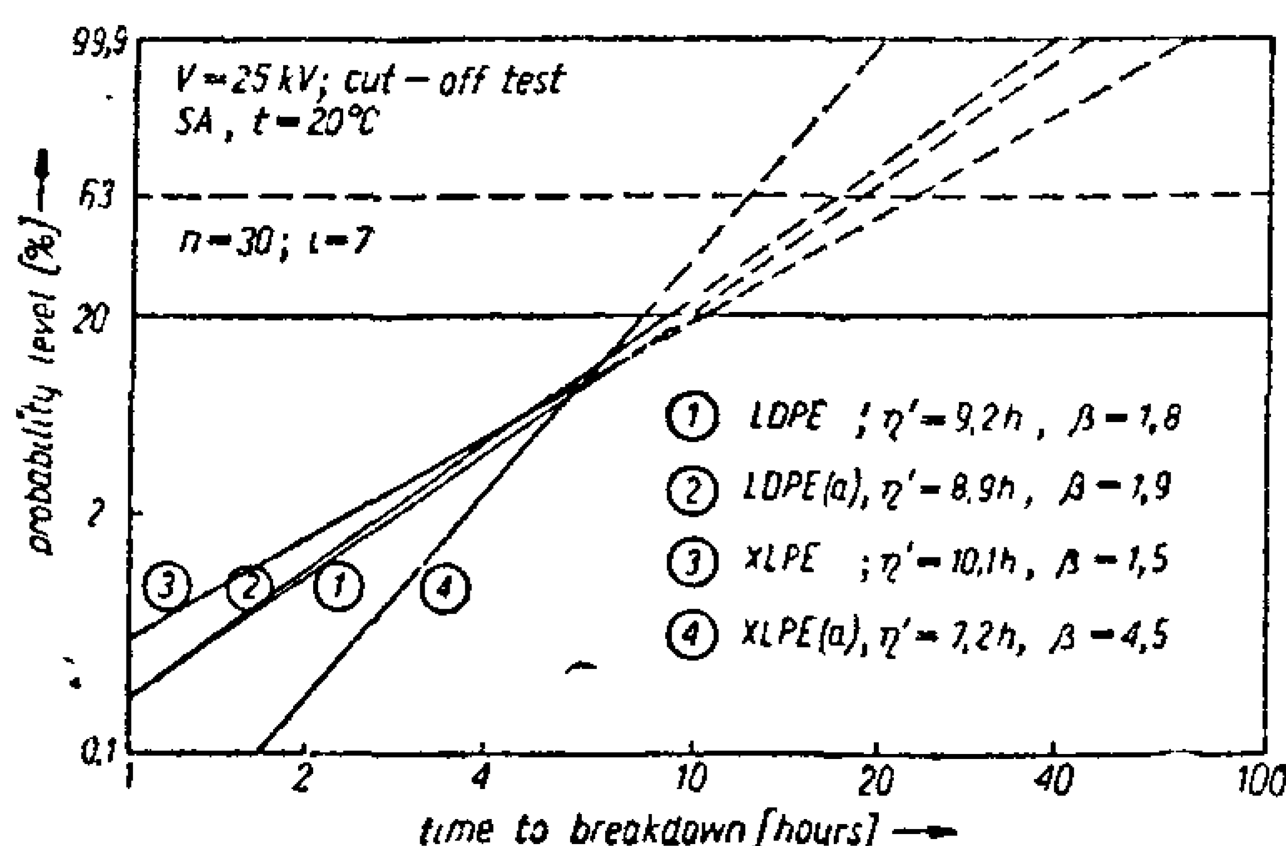


Fig. 2 Distribution of time to breakdown in Weibull coordinates. SA tests at 20°C.

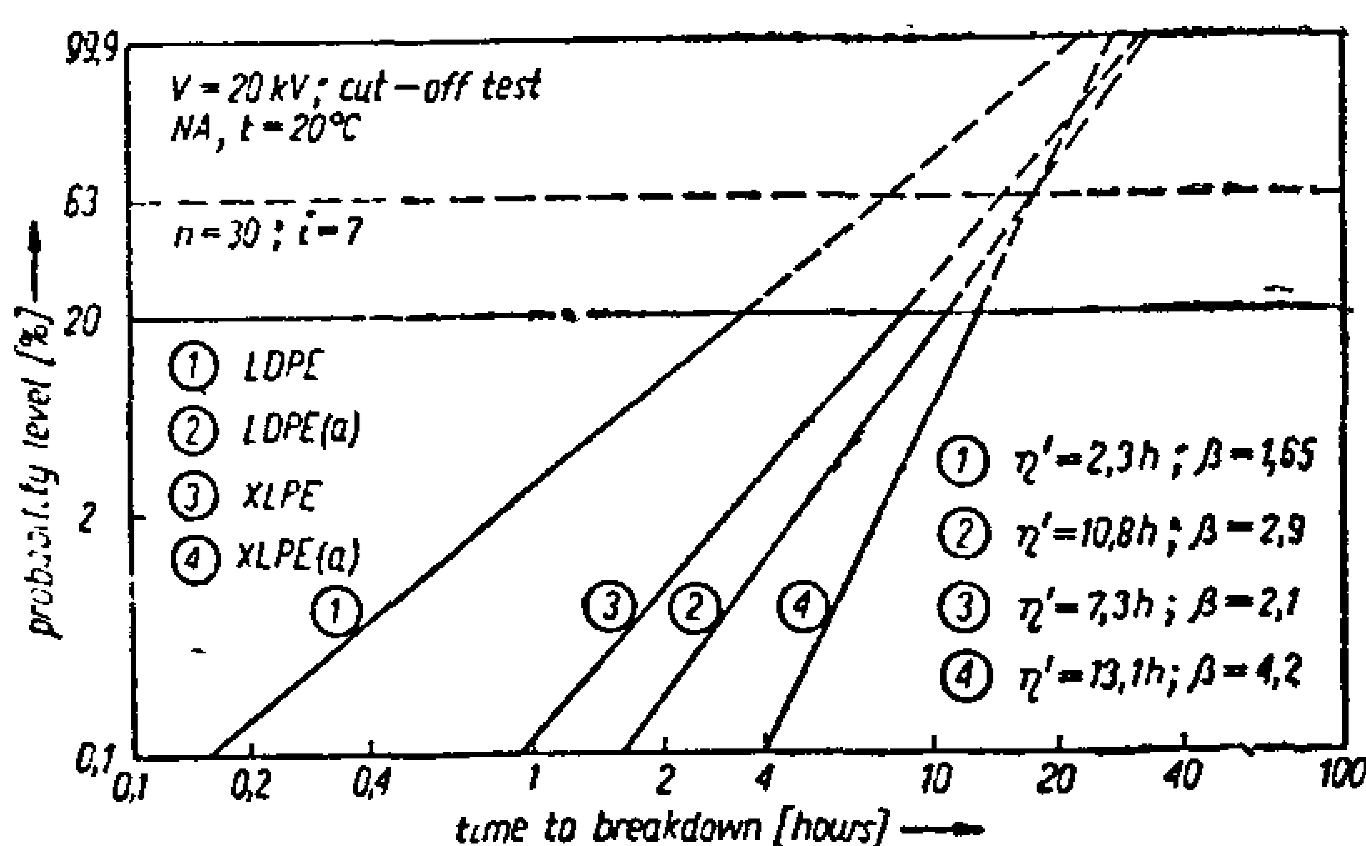


Fig. 3 Distribution of time to breakdown in Weibull coordinates NA tests at 20°C.

They indicate that in SA there is no clear difference in η' values obtained for different sets of samples, i.e. LDPE and XLPE do not differ much as well as there is only little influence of additive. However, the influence of cross-linking and additive is well visible in NA, thus, both materials are better when saturated.

Results obtained at elevate temperature are displayed in Fig. 4 and 5. They show the general tendency of decreasing of parameter η' in all cases investigated when temperature is higher.

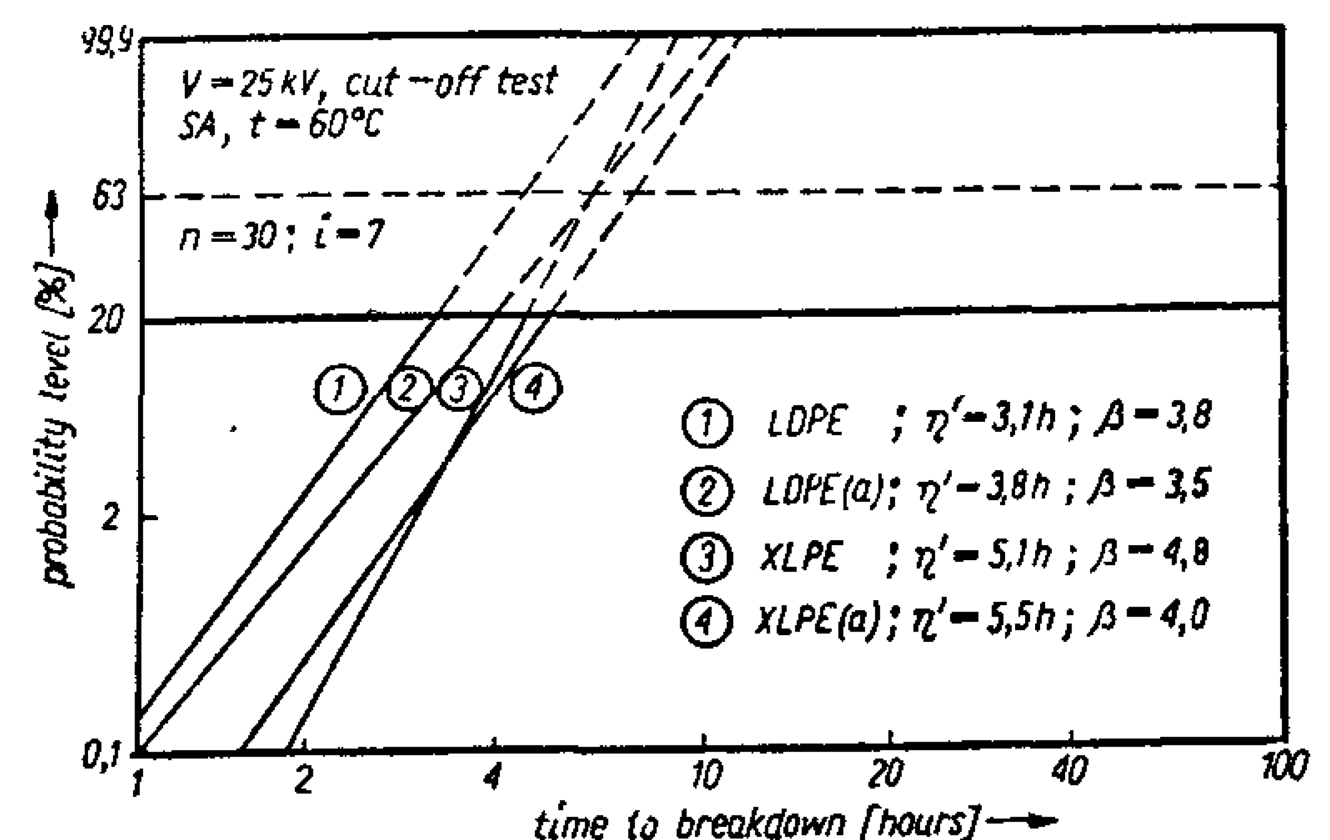


Fig. 4 Distributions of time to breakdown in Weibull coordinates. SA tests at 60°C.

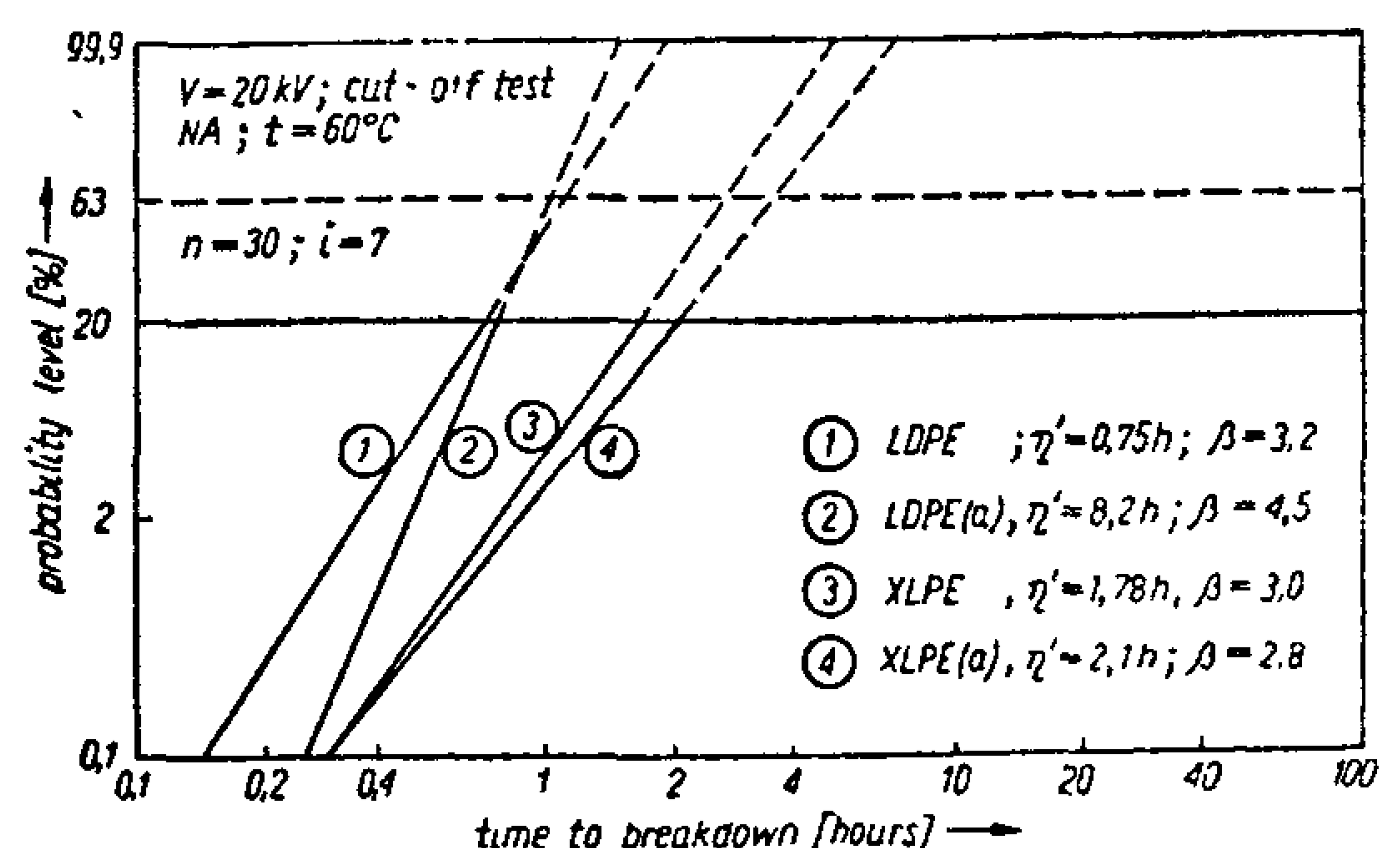


Fig. 5 Distributions of time to breakdown in Weibull coordinates. NA tests at 60°C.

The differences in SA are visible as the values for XLPE are larger than those for LDPE. Also they increased for saturated materials.

Preparation of samples and electrodes introduced a controlled process. Also suitable methods of examination and selection of specimens were adopted (14, 15).

For testing in SA, two parts of sample 40x40 mm large were cut from moulded plaques 1 mm and 6 mm thick. Cylindrical void with diameter 3 mm in the upper part of a sample (6 mm thick) was formed mechanically having its walls and edges carefully smooth out.

In the void the rod electrode was positioned with the distance 0.5 mm above the surface of lower part of dielectric sample. The foil spacers 100 um thin were used to separate two parts of sample. The whole model was fixed by clamping of two parts of sample with rod and flat electrodes.

The sample size in one serie of measurements was n = 30. Tests were carried out till breakdown of first 7 samples at the constant voltage level V = 25 kV.

For testing in NA, samples were cut from moulded plaques 6 mm thick. The elecrodes used were made in Japan OGURA needles with the radiuses of curvature of their tips 3 um.

They were inserted into the block of material by specially adopted technique. Separation of needle electrode and flat electrode was 2 mm.

The sample size was n = 20 and the voltage level was kept at the constant level V = 20kv until first 7 samples broke down.

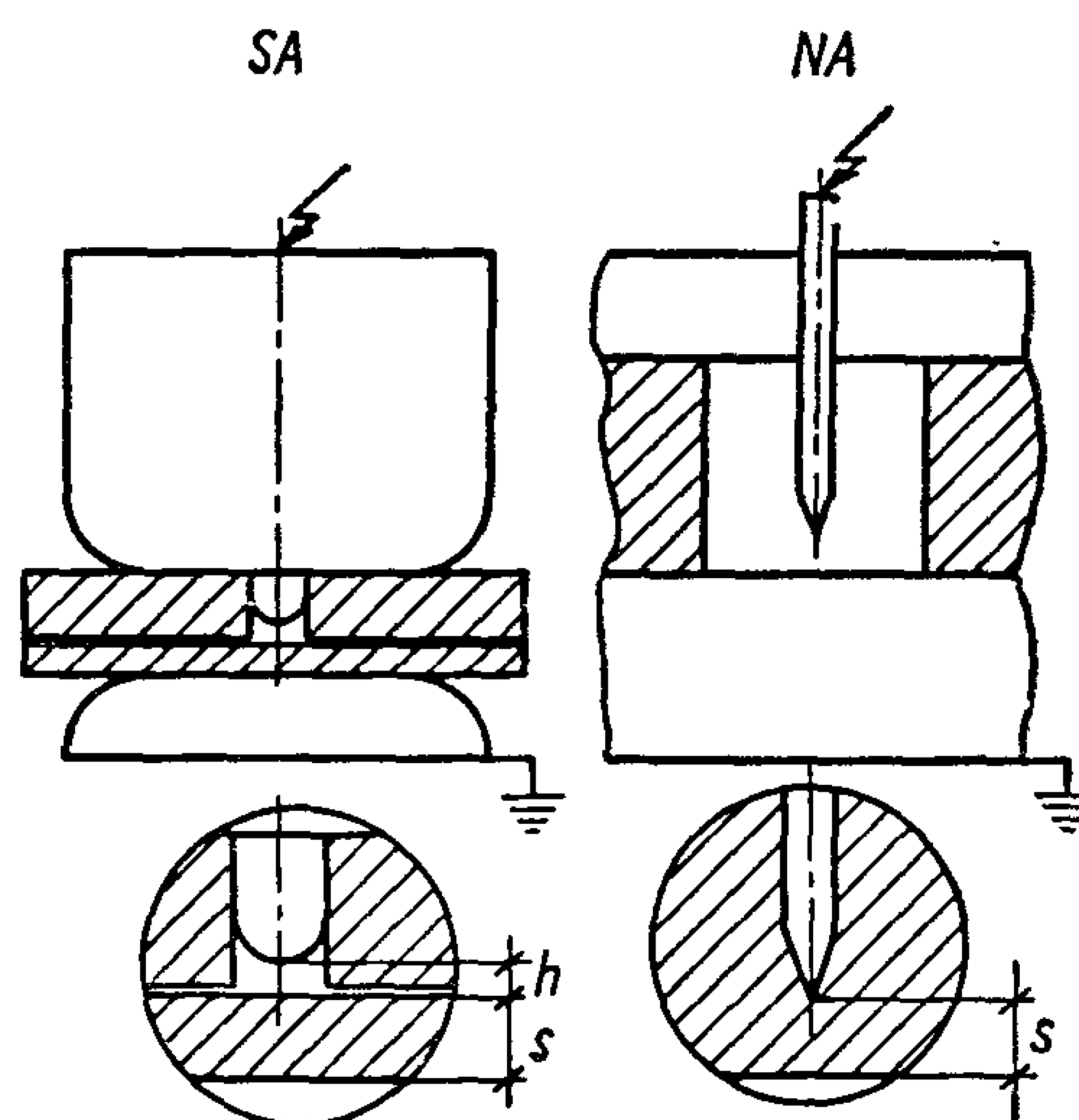


Fig. 1 Model arrangement used during tests.

Two different polyethlene materials were used : LDPE and XLPE type. Their basic properties are given in Table 1. Dodecanoladditive/$C_{15}H_{25}OH$/ was employed for saturation of samples were tested at each temperature level.

The temperatures of testing were 20°C and 60°C.

Table 1

	LOPE	XLPE
Density/g/cm^3	0,920	0,925
Crystallinity/%/	40	30
Permittivity	2.2	2.3
Loss tangent	2.4x10^{-4}	4.0x10^{-4}
Dielectric strength/kv/mm/	52	60
Volume resistivity/ Ω cm/	2.8 . 10^{16}	5.9 . 10^{15}
Surface resistivity/ Ω /	2.2 . 10^{16}	1.2 . 10^{16}

field concentration is simulated by a tip of the metal electrode embeded into a bulk of the material.

In spite of significance of ET, some data already presented /4, 5) show that another degradation mechanism can be dangerous for different plastic materials, when PD can develop into broad, very narrow slit between two dielectric layers or between dielectric and semiconductive or even conductive surface.

Such discharges and their interactions with dielectric materials can be introduced in the so-called slit arrangement. In this arrangement surface tree-like traces of pse-breakdown channels can develop leading to relatively quick breakdown.

The possibility of existence of such slit-type sources of PD (in different types of insulation) was already reported by some authors (6,7).

It seems to be important to investigate the behaviour of different dielectrics and among them of polyethylene materials when affected by different types of discharges as they can be equally dangerous (8).

There are several factors affecting the life of insulating materials stressed in a.c. electric field when progressive degradation occures. One of this factors can operate with the change of temperature conditions.

Some data available show that the rising of ambient temperature during the testing of different materials decrease the life of sample with surface PD (9) or decrease the inception voltage of ET (10, 11). Some other references make a point at the influence of temperature on the basic dielectric properties of dielectrics and the decrease of breakdown strength with rising temperature (12, 13). The latter references quotet concern the polyethylene materials.

However, there is still little comparative data explaining the ability of polyethylene to withstand the breakdown caused by different degradation processes at elevated temperatures.

The investigations reported partially in this paper aimed at studying the difference of life time of different polyethylene materials, assessed by breakdown due to partial discharges developing: (a) surface type tree-like channels and (b) volume type tree-like channels, obtained in slit arrangement (SA) and needle arrangement (NA) at normal and elevated temperatures. The measurements of time to breakdown were performed during the static voltage tests at constant voltage level. The method of cut-off tests was performed, thus, every test was limited till first few breakdowns.

The tests were based upon a concept that with the repeatable and selected sample size the experimental results of either slit tests or needle tests fit the two-parameter Weibull distribution, thus, cut-off tests carried out with a censored sample size can be suitable as a method of comparative testing of resistance of solid dielectrics to different degradation processes (14).

2. Experimental

In the both arrangement used the great attention was paid to the purity and reproducibility of the specimens, in particular, to the assessment of accuracy of geometrical dimensions (spacing of electrodes, geometry of void and slit, raduis of curvature of rod and needle electrodes/; of state of interfaces between two dielectrics (gas-dielectric boundary conditions) and between metal and dielectric; of mechanical stresses in the dielectric material present due to insertion procedure.

THE RESISTANE OF POLYETHYLENE TO BREAKDOWN BY PARTIAL DISCHARGES AND TREEING AT NORMAL AND ELEVATED TEMPERATURES

N. Farrag* A. Sierota**

SUMMARY

A major cause of failure of polyethylene cables during their service is the progressive degradation due to partial discharges (PD) and electrical treeing (ET). PD in broad, narrow slits can initiate and develop surface tree-like channels while ET appears as the result of growth of tubular volume tree-like channels.

The both mechanisms can provoke relatively quick breakdown when electric stressing is sufficiently high.

The resistance of polyethylene materials to the above degradation processes can be tested in model arrangements namely, in slit arrangement (SA) and needle arrangement (NA).

Two polyethylene materials, LDPE and XLPE without and with inhibiting additive were tested in SA and NA at normal (20°C) and elevated (60°C) temperatures

Repeatable, selected specimens were taken for tests cut-off after several breakdowns. Time to breakdown at 20% probability level was the parameter of Weibull distribution of results, taken for comparative purposes.

The results obtained indicate that increasing of ambient temperature can greatly accelerate the breakdown.

The effect of crosslinking and saturation by additive can be different in both arrangements used and dependent on the temperature. The studies require further development.

1. Scope

Many experimental data available show that a major cause of failure of synthetic insulations during their service are progressive degradation processes due to internal partial discharges (PD) and due to electrical treeing (ET).

For many ears intensive studies of either PD or ET have been carried out and results were summarised in several sources Some of them are indicated here /1-3/.

In the recent perior, due to great improvement of technology of manufacturing of cast, extruded, molded and other insulations the significance of «classical» internal void-type discharges apparently decreased and ET is understood to be the main degradation mechanism destroying the insulation e.g. of synthetic cables.

The testing of materials against degradation by ET assume, in general, exposing of a material sample to localised, highly divergent field while the average voltage gradient remains at resonable value. This can be done either by insertion into material sample of a gas microcavity or of a solid inclusion. However, the modelling of highly divergent fields in dielectric sample have always been done by introduction of different needle arrangements (3) in which the source of local

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mely non-linear, dynamic, and approximated linear approach. In this paper the dynamic (step by step non-linear technique) is chosen.

Solution algorithm

(1) For a given daily load curve, the initial economical cost of the production energy is calculated.

(2) A managed power amount Δ M is shifted from peak to off-peak periods, the objective function is calculated taken into consideration the above mentioned constraints.

(3) The saving cost from the above two steps is calculated.

(4) Considering the cost calculated in the last step as an initial cost, and increasing the managed power amount by Δ M, then recalculate the cost saving.

(5) Repeat the above process until the saving calculated from the last two steps be smaller than the predetermined value.

(6) The sum of Δ M, s is the optimal managed load required to minimize the production energy cost.

Applying this algorithm on the previous example the optimal value of $\sum \Delta M$ was 22%.

CONCLUSIONS

This paper presents a new technique for optaining the optimal load management to minimize the production energy cost.

It also realizes that any number of different load duration curves can map into the same load factor.

The given numerical example show the effectiveness of load managed for reducing the production energy cost.

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Table II : The percentage reduction of peak power, the percentage reduction of fuel cost, and daily load factor :

% peak power reduction	% fuel cost reduction	Load factor
5	3.509	0.719
10	6.81	0.759
15	9.41	0.803
20	9.418	0.854
25	10.66	0.911
30	12.68	0.975

Optimal load management :

As shown from table II the fuel cost of generation decreases as the load factor increases, this decrease will be continue until the load factor approaches unity. In fact that is not the real cost because the cost of load management tools was neglected. If we take the cost of load management tools into consideration, the total cost will be increased. The objective of optimal load management is to minimize the sum of the energy production cost and the cost of load management tools.

The problem may be formulated as follows :

minimize

$$\sum_{i=1}^{N}\sum_{K=1}^{a} F_i T_K + \sum_{K=1}^{a} F_{mK} \quad (9)$$

Subject to the set of equalities and inequalities constraints :

$$\sum_{i=1}^{N} P_{iK} - P_{LK} + M_K - R_K - P_{loss_K} = 0$$
$$(K=1,2,\dots,a) \quad (10)$$

$$\sum_{K=1}^{a} M_K T_K - R_K T_K = 0 \quad (11)$$

$$P_{i_{min}} \leqslant P_i \leqslant P_{i_{max}} \quad (K=1,2,\dots,a) \quad (12)$$

$$M_K \geqslant 0 \quad (K=1,2,\dots,a) \quad (13)$$

$$P_K \geqslant 0 \quad (K=1,2,\dots,a) \quad (14)$$

$$P_{LK} + M_K \leqslant S_{max} \quad (K=1,2,\dots,a) \quad (15)$$

$$P_{LK} - R_K \leqslant S_{min} \quad (K=1,2,\dots,a) \quad (16)$$

where

F_i fuel cost function in \$/hr

F_m cost of load management tools in \$.

P_{iK} active power generation from generator (i) at interval (K)

min, max are indices define the minimum and maximum values respectively

P_{LK} load demand at interval K

T_K time interval

a number of intervals

M_K managed load from peak period at interval K

R_K managed load to off-peak period at interval K

S_{max} maximum power demand of daily load curve

S_{min} minimum power demand of daily load curve

F_i, F_m can be calculated from the following approximate equations

$$F_i = A_g P_i^2 + B_g P_i + C_g, \quad (17)$$

$$F_{mK} = A_m R_K^2 \; B_m R_K + C_m, \quad (18)$$

$$P_{Loss_K} = \sum_{\substack{i=1 \\ i\neq j}}^{N} \sum_{\substack{j=1 \\ j\neq i}}^{N} P_i P_j B_{ij}$$
$$(K=1,2,\dots,a) \quad (19)$$

where $A_g, B_g, C_g, A_m, B_m, C_m$ are quadratic cost coefficients and B_{ij} is the coefficient of loss formula.

The upper formulation gives a non-linear optimization problem, which may be solved by the following techniques. Na-

The daily load factor (Lf) is

$$Lf = \frac{D}{24\,P_{max}} = \frac{\int_0^{24} P(t)dt}{24\,P_{max}} \quad (2)$$

Where P_{max} is the peak power demand The sensitivity of fuel costs to load facter depends on the incremental energy costs, $\partial c/\partial w$

where (C) and (W) denoted the fuel cost per megaWatt hour and instantaneous energy demand.

After load management is employed, the m (t) megawatts are shifted from the peak to the off-peak periods, the daily load factor improves to :

$$Lf' = \frac{\int_0^{24} (P(t)+m(t))dt}{(P_{max}-m(t_{peak})).24} \quad (3)$$

If the peak period is $a \leq t \leq b$ and the off-peak period is $c \leq t \leq d$,then

$$m(t) = \begin{cases} -M & a \leq t \leq b \\ +M & c \leq t \leq d \\ 0 & \text{otherwise} \end{cases}$$

The sensitivity of the load factor to the managed energy calculated is as follows :

$$W = \int_a^b m(t)\,dt \quad (4)$$

$$\frac{d(Lf')}{dW} = \frac{\partial(Lf')}{\partial M} \cdot \frac{dM}{dW} = \frac{1}{(b-a)} \cdot \frac{\partial(Lf')}{\partial M} \quad (5)$$

but

$$\frac{\partial(Lf')}{\partial M} = \frac{\int_0^{24}}{(P_{max}-M).24} \quad (6)$$

thus

$$\frac{d(Lf')}{W} = \frac{1}{24(b-a)(P_{max}-M)^2} \cdot \int_0^{24} P(t)dt \quad (7)$$

then the sensitivity of fuel costs to load factor,

$$\frac{dC}{d(Lf')} = \frac{\partial C}{\partial W} \cdot \frac{dW}{d(Lf')} = \frac{24(b-a)(P_{max}-M)^2}{\int_0^{24} P(t)dt} \cdot \frac{\partial C}{\partial W} \quad (8)$$

Numerical example

As an example to show the effectiveness of load management for reducing the cost of production energy, consider the daily load curve shown in figure (1) which is supposed to be supplied by three thermal power stations. The fuel costs of these plants can be approximated by the following equations :

$$F_1 = .002P_1^2\ .8P_1 + 25 \ \$/Hr.$$

$$F_2 = .003P_2^2 + .78P_2 + 30 \ \$/Hr.$$

$$F_3 = .004P_3^2 + .6\ P_3 + 32 \ \$/Hr.$$

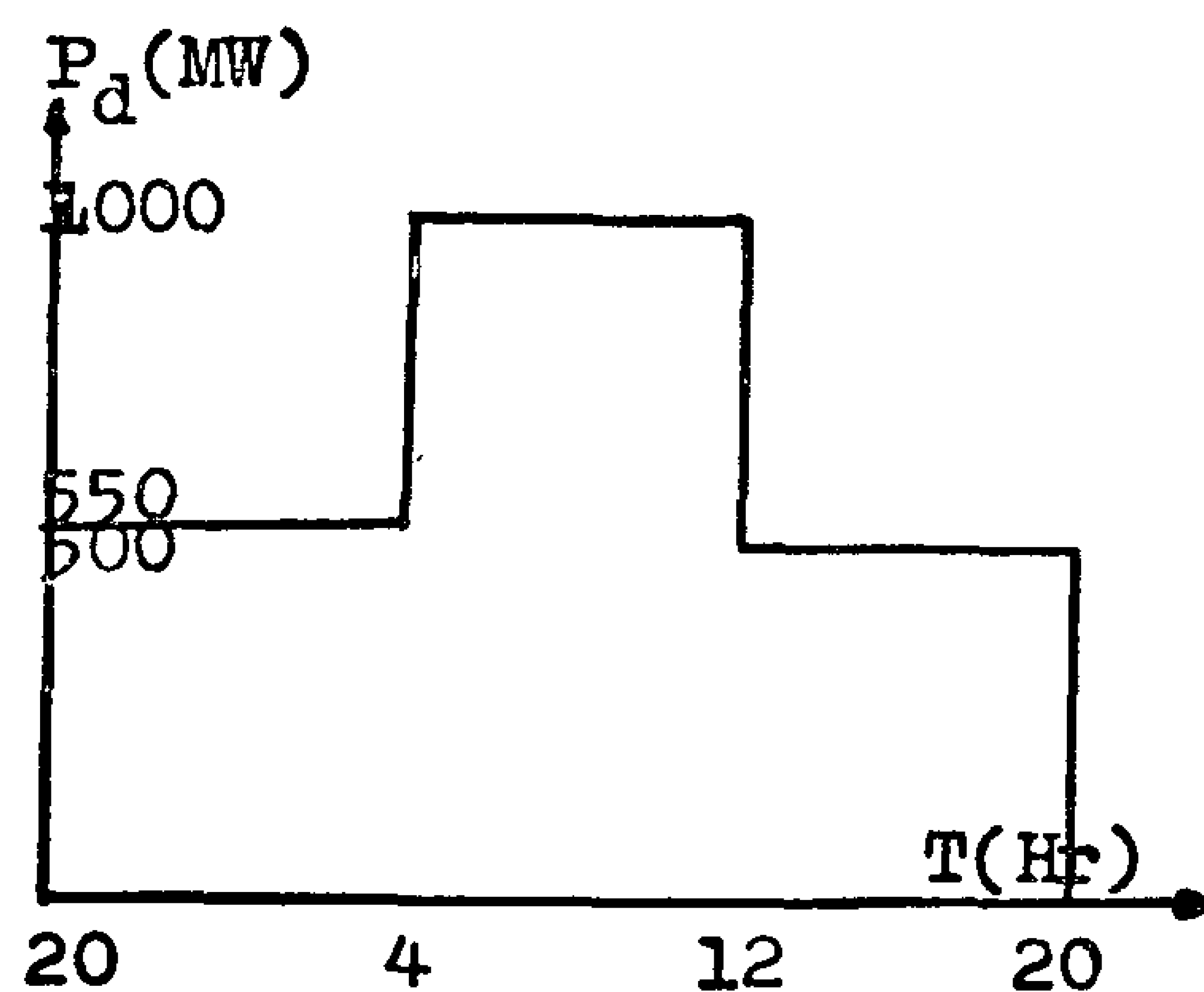


Fig.(I)

The loss formula coefficients of the system are given in the table I in 1/M

Table I: The loss formula coefficients of the system :

i \ j	1	2	3
1	0.0004	0.0001	0.0001
2	0.0001	0.0003	0.0001
3	0.0001	0.0001	0.0002

Table II givs the percentage reduction of peak power (m(t)), the corresponding percentage reduction of fuel cost, and daily load factor.

REDUCTION OF ENERGY COST BY LOAD MANAGEMENT

S.A. Othman*

M.M. El-Gazar*

Load management technology and system-wide load management programs have been in existence for over a decade. The success of any utility load management program depends on the degree to which a load can be controlled during periods of system generation, transmission, and distribution capacity shortages or during periods of high fuel cost.

The economic impetus for developing a load management program has been restricted to improving the efficient use of the three utility resources : purchased power, fuel, and generation sources, but no effort has been directed toward evaluating the change in the efficiency of the energy delivery system. Cost analysis of load management programs have usually been drived monitroing only the altered load profiles at the terminal of energy conversion device, but these analyses have conventionaly not considered the economics of these modified load profiles on the system.

This paper presents a new alogrithm to give the optimal reduction of the peak power and choose the optimal redistribution of this power overall the load curve to minimize the total energy cost.

It is also presents the sensitivity of fuel cost to daily load factor.

Introduction

As currently understood in the power industry, load management refers to the use of load control measures to reduce peak loads and increase baseloads. In a thermally dominated power system it is customary to meet off-peak loads with the generating equipment that operates at lowest incremental cost, restoring to units with higher heat rates (costs) only as load moves into peak ranges. This means the off-peak marginal cost of power is only slightly more than heat rate times cost of base-load fuel, in cents per British thermal units. Since peak power is generated at much higher costs than off-peak power-and is therefore "worth" more to the system-it has been possible to reduce overall system costs by shift peak lead to off-peak periods will also improve load factor.

This paper presents the relationship between load factor and load management. Also it presents the optimal shift in peak power to minimize the overall energy production cost.

Sensitivity of fuel costs to load factor :

If the daily load curve of an electric power system is P (t) magawatts, $0 \leq t \leq 24$ with (t) in hours, the total daily energy demand in megawatt hours is D,

$$D = \int_0^{24} P(t)\, dt \quad (1)$$

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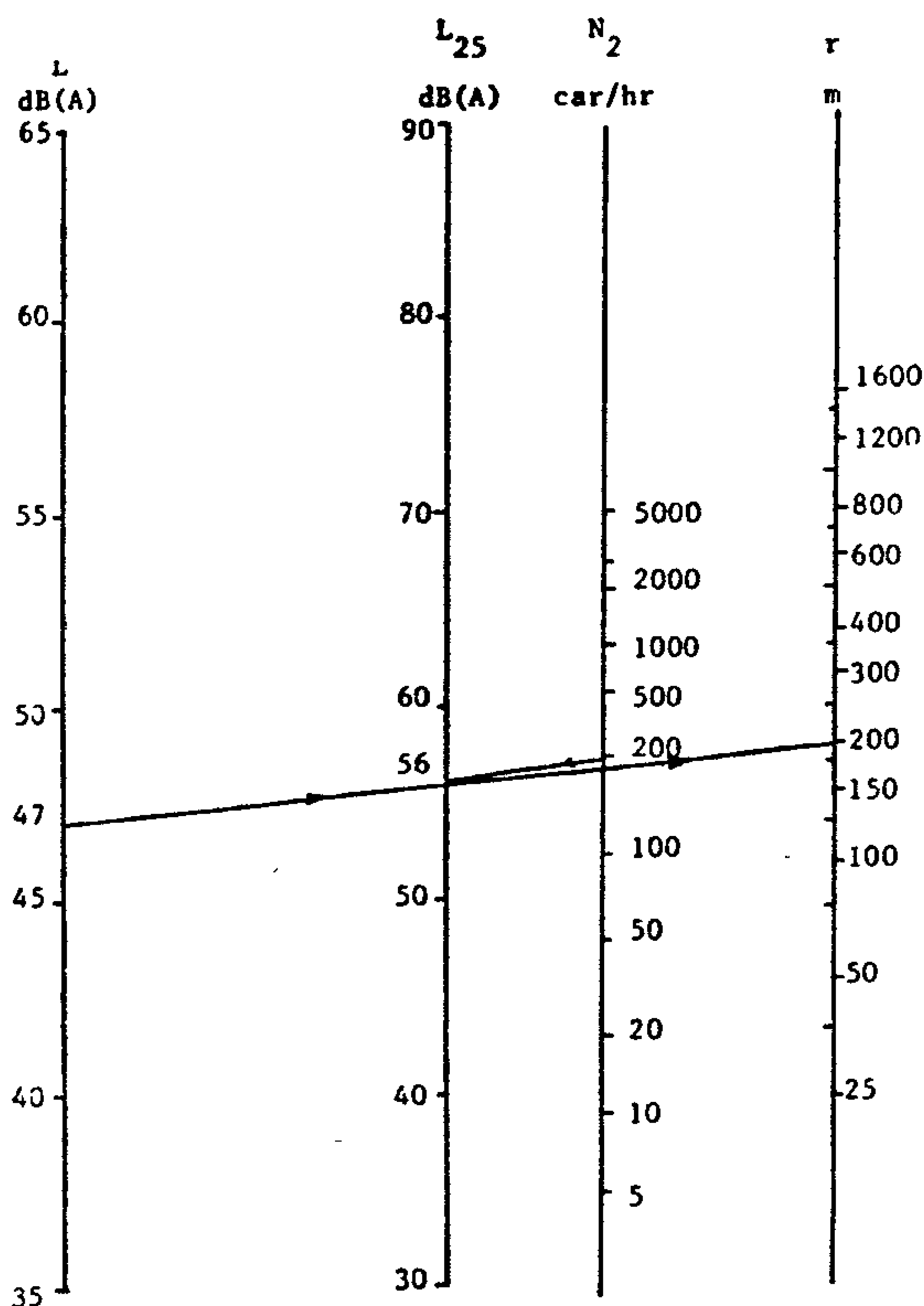


Fig. 4. Normogram for determining the minimum distance between the road and the school building.

6. CONCLUSION

From the above measurements and interpretation it can be concluded that :

The noise level in the school classes on the main road is very high compared to the standard values of the sound pressure level SPL in dB (A), the preferred noise criteria PNC and the noise rating NR. To reduce the noise level in there school classes, the above mentioned treatments must be carried out.

In future, it should be taken into consideration, the minimum distance between the school buildings and the main roads.

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This excess in noise level is considered to be anuisance and the intelligbility of speech, which is the main factor in the classrooms, will be decreased. It is known that the intelligibility of speech is affected by the noise level. Consequently understanding of the pupils will be decreased. In addition, the presence of the high background noise will provoke the teacher to raise his voice. This leads to the stress of vocal chords.

To reduce the noise level in the above school classes, it is recommended to carry out the following:

1. Replace the steel fence of the school by a building one with suitable height, in which the upper part can be made of timber and used for advertisement.

2. Different rows of hedges with high density between the building fence and the school building must be planted.

3. Windows must be double glazing with suitable thickness and with sound absorbing material at the edges.

5. MINIMUM DISTANCE BETWEEN ROAD AND SCHOOL BUILDING

The main factors govering the exposure of the school building to noise from a road are the traffic density and the distance between the road and the exposed facade of the building. Since there are different types of traffic (private car, lorries, tranways, motor bicycles and mopeds), an equivalent number of the private cars is deduced for each type of the other traffic, so that the noise level from it is equal to the noise level from each unit of the corresponding traffic[4,5].

The relation between the equivalent continuous noise level at a distance of 25m from the center of the road and the traffic density N2 can be expressed as:

$$L_{25}=26+13\lg N_2-L \text{ dB (A)} \quad (1)$$

where

$$L=3\lg\left(\frac{N_2}{200}\right),\quad N_2>200$$

$$=0 \qquad N_2\leq 200$$

the traffic density is given by :

$$N_2=N_c+4N_l+4N_t+3N_m+3N_p \quad (2)$$

where

N_c=No. of cars/hr.

N_l=No. of lorries/hr.

N_t=No. of tramways/hr.

N_m=No, of motor bicycles/hr.

N_p=No, of mopeds/hr.

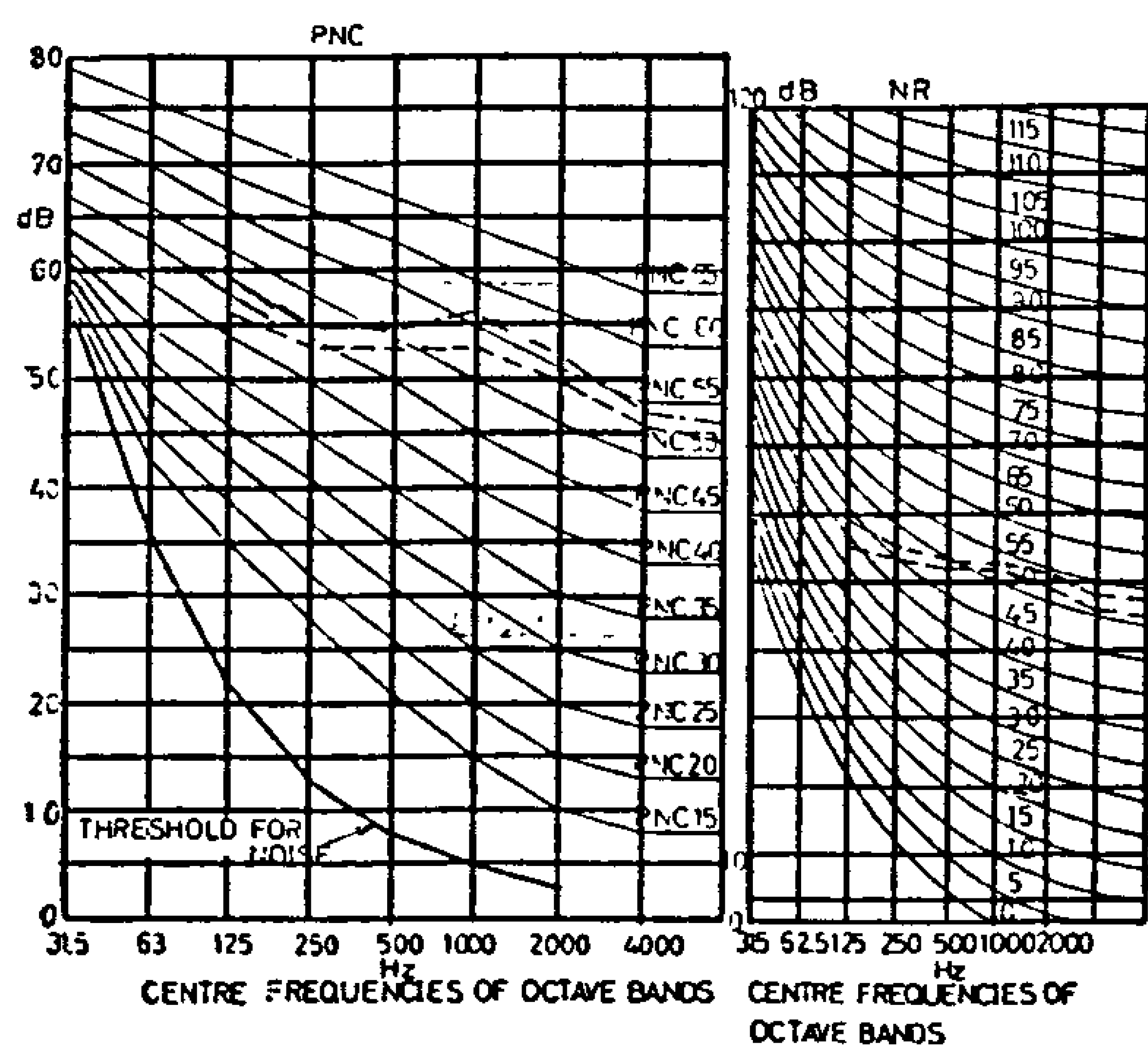
The noise level at any distance r from the center of the road can be calculated from the equation[4,5]:

$$L_r=L_{25}-10\lg\left(\frac{r}{25}\right) \text{ dB(A)} \quad (3)$$

where r is expressed in meters.

A normogram is made, to determine the minimum required distance between the center of the road and the school building[6]. Fig. 4 shows an example to use the normogram. As example to use the normogram. Assume the traffic density in both direction is to be : 74 private cars, 14 tramways, 4 lorries, 12 motor bicycle and 6 mopeds. The equivalent traffic density according equation (2) is 200 private car/hr. The corresponding noise level L_{25} according to equation (1) is 56 dB. As shown in table (1) the maximum permissable noise level in the classroom is 47 dB (A). Then, according to equation (3) the minimum distance between the center of the road and the facade of the school is 199 m.

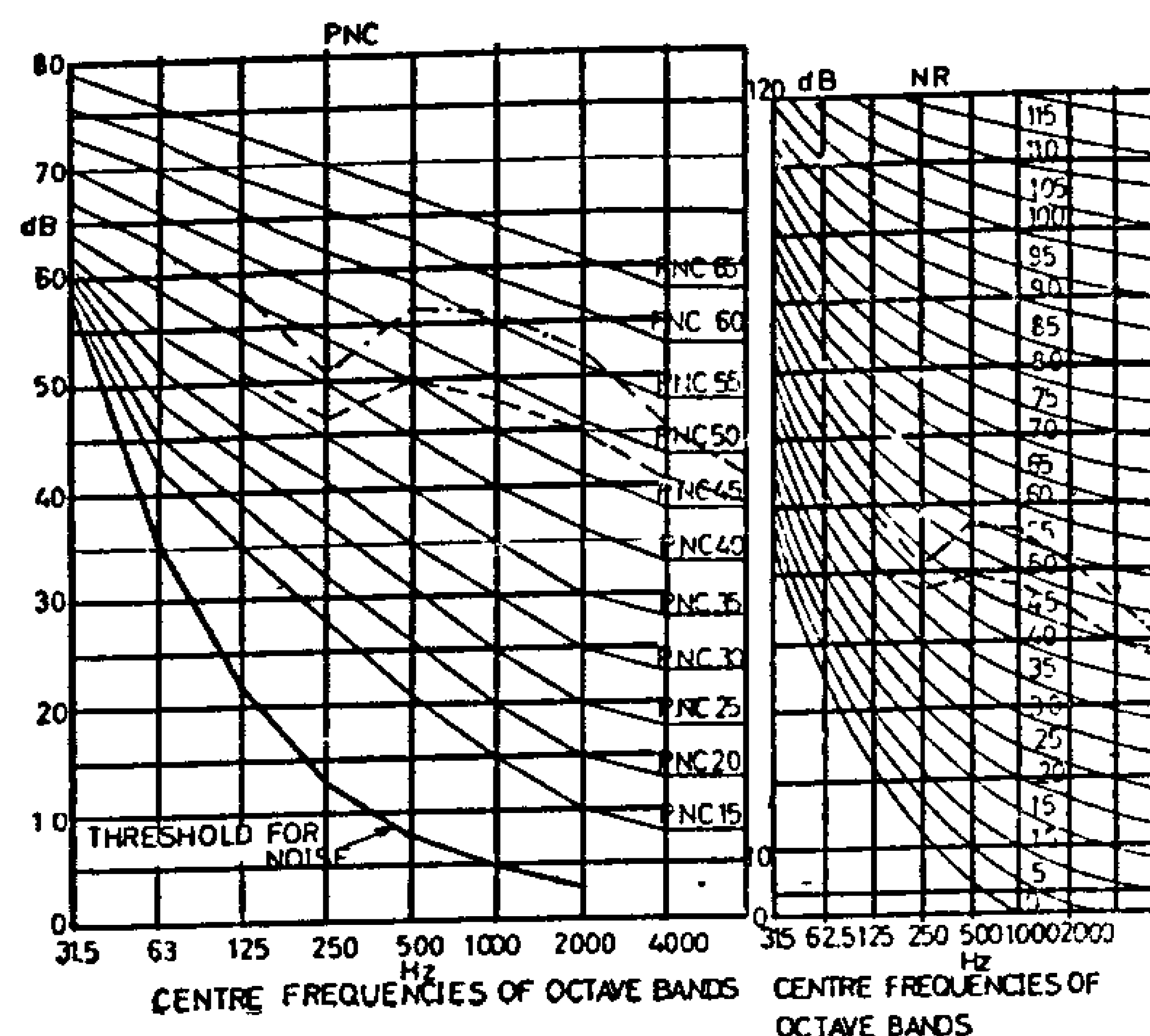
The results of the measurments are shown in figures 1,2 and 3. From table 1. the preferred noise criteria for classrooms is ranged from PNC 30 to PNC 40 and the approximate sound pressure level in dB(A) attains a value from 38 dB(A) to 47 dB(A). From table 2. the noise rating number for classrooms is basically NR 25, which can be increased for urban residental to NR 30. As shown in fig. 1. the SPL in the classroom in the agricultural school is 66 dB(A) and 61.5 dB(A) for the open windows and closed windows respectivily. The above values are very high compared to the standard permissable value of SPL which is from 38 dB(A) to 47 dB(A) The measured preferred noise criteria for the same classrooms is PNC 55, while the corresponding NR curve is NR 55. The above measured values are very high compared to the standard values which are PNC 30 to PNC40 and NR30. As shown in fig.2. the sound pressure level SPL in the classroom in the commerical secondary school is 65 dB(A) and 58 dB(A) for the open windows and closed windows respectivily. The measured PNC values are also PNC 55 and PNC 50, while the corresponding NR values are NR 55 and NR 50. These measured values are also high compared to the standard values.



—.— A classroom on the facade, windows open, at 2.5 pm (66 dB (A))

———A classroom on the facade, windows closed at 2.5 pm (61.5 dB (A))

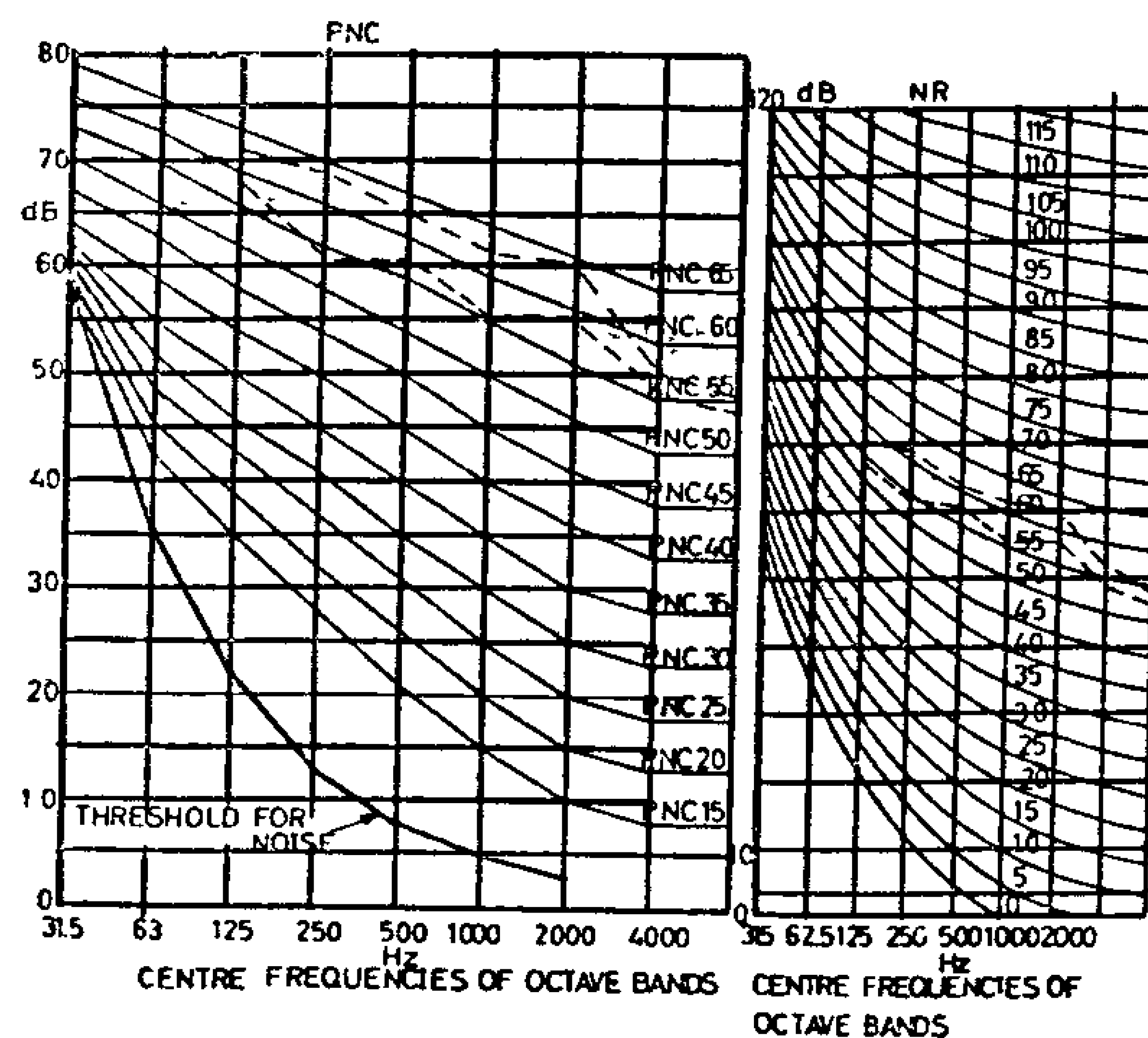
Fig. 1. The noise level in a classroom, the agriculture secondary school.



—.— A classroom on the facade, windows open, at 3 pm (65 dB (A))

——— A classroom on the facade windows closed at 3 pm (58 dB (A))

Fig. 2. The noise level in a classrom, the commercial secondary school.



—.— A classroom on the facade, window closed, at 11 am

-—.— A classroom on the facade, window, closed, at 11 am

Fig. 3. The noise level in the third school on main road.

In the third school the preferred noise criteria values are PNC 65 and PNC 60, the noise rating are NR 65 and NR 60 for the open window and closed window respectivily. Also the above values of PNC and NR are very high compared to the standard permissible values.

From the above results it can be observed that the noise levels in the above classrooms are much higer than the recommeded values of SPL(A), PNC or NR.

3.3. Noise rating NR:

In Europe, KOSTEN and VAN-OS 1962 have developed a system which is similar to PNC. This system is called Noise Rating[2,3]. In Table 2 the recommendation of KOSTEN and VAN-OS for various types of accommodation in term of NR are shown.

Table (2)

Category of accommodation	Noise rating
Broadcasting studio	15
Concrete halls, drama theatre 500 seats	20
Class room, music room, TV studio, conference room	25
Bedroom (it is possible to use correction).	25
Conference room 200 seets or with public address system, Cinema, hospitals, library.	30
Living room (it is possible to use correction).	30
Private office	40
Restaurant	45
Gymnasium	50
Office (typewriters)	65
Workshop	65

4. EXPERIMENTS AND RESULTS

The noise levels in some school classes on the main road are measured. The precision integrating sound level meter with built-in octave filter, from the type Bruel & Kgaer was used for the measurments of the noise level using A-weighted network, or the sound pressure level SPL at certain octave band in the frequency range from 125 Hz to 8000 Hz. The school classes in which the measurments are carried out can be classified into the following:

1. The agricultural secondary school which is laying in El-haram street, Cairo,

2. The commercial secondary school which is laying on El-haram street, Cairo,

3. A school which is laying on an main street, Cairo.

ment of noise at source-, annoyance or potential damage of hearing, the frequency spectrum of noise must be undertaken.

3.2. Preferred noise criteria PNC

This system consists essentially of the construction of a set of arbitrary sound spectra-octave analysis to serve as a frame of reference for rating noise environments[2]. In use, the spectrum under investigation should not exceed the values in each of the octaves specified, and it is allowed to exceed the PNC in one octave by up to 2 dB, provided the octaves above and below are not more than one dB below of the PNC curve. The suitability for various indoor uses of different sound levels and PNC values are given in Table 1.

Table 1.

Types of space (and acoustical requirements)	NC of PNC Curve	Approximate sound level dB (A).
Concert halls, opera houses and recital halls (for listening to faint musica.).	Not to exceed 15	26
Broadcast and recording studio(distant microphone pick-up used).	Not to exceed 20	30
Large auditoriums, large drama theaters and churches (for very good listening conditions).	Not to exceed 20	30
Broadcast, television and recording studio (close microphone pickup used only).	Not to exceed 25	34
Small auditorium, small theatres, small churches, music rehearsal rooms, large meeting and confrence room (for very good listening), or executive office or confrence room for 50 people(no amplification).	Not to exceed 35	42
Bedrooms, sleeping quarters, hospitals, residenas apartments, hotels, motels, etc(for sleeping, resting, relaxing).	25 to 40	34 to 47
Private or semiprivate offices, small conference rooms, classrooms, libraries, etc(for good listening conditions).	30 to 40	38 to 47
Living rooms and drawing rooms in dwelling (for conversing or listening to radio and TV).	30 to 40	38 to 47
Large office, reception areas, retail shops and stores, cafeterias, restaurants, etc(for moderately good listening conditions).	35 to 45	42 to 52
Lobbies,laboratory work spaces, drafting and engineering rooms, general secretarial areas(for fair listening conditions).	40 to 50	47 to 56
Light maintenance shops, office and computer equipment rooms, kitchens and laundries (for moderately fair listening conditions).	45 to 55	52 to 61
Shops, garages, power - plant control rooms, etc (for just acceptable speech and telephone communication).	50 to 60	56 to 66
For work spaces where speech of telephone communication is not require, but where there mush be no risk of hearing damage.	60 to 75	66 to 80

NOISE LEVEL IN SCHOOL CLASSES IN EGYPT

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The noise level in some school classes in Cairo is carried out. As an example three schools which are laying on the main road are chosen as specimen. The noise level in these places is analysed and compared with the standard permissible values of SPL in dB (A), PNC or NR. The results show that: The noise level in all measured places is high compared to the standard values and noise abatment must be used. For the above reason it should be taken into consideration in future the minimum distance between the schools and main roads.

I. INTRODUCTION:

In recent time many machines have been developed for industrial purposes, for high-speed transportation or to make life enjoyable. These developments are accompanied by noise. Since noise affects man in a number of ways-his hearing, his ability to communicate and his behaviour-noise control, from both economic and medico-legal stand points has become tremendously important.

In this work the noise level in some schools classes is investigated. The resilts are compared with the standard permissible values such as sound pressure level SPL in dB (A), the preferred noise criteria PNC and the noise rating NR. For every studied case, the method of noise control is described.

2. NOISE:

Noise is defined subjectively as «unwanted sound»,[1]. The source of noise can be divided into natural sound and man made noise such as: road traffic, air craft, trains, industry, construction noise, domestic (light appliances), neighbour's impact noise (knoking, walking... etc), childern, adultvoice, wireless (TV & radio), and bell (alarm). All these sources of noise cause annoyance[2], which is subjective criteria i.e. can not be measured by objective methods. Noise survey made by the Building Research Station and the Central Office of Information in 1961-1962., in London[2,3], showed that: from 100 people questioned 99% found noise disturbance at home, 35% outdoors and 26% at work. This study indicated also that the road traffic noise is the main source of noise.

3. METHODS TO MEASURE NOISE:

The main methods to measure noise are:

3.1. Sound pressure level in dB.

By this method the overall sound pressure level in dB at any time is measured by sound level meter. The sound pressure level is defined as:

SPL = 20 Log p/po dB where, p : the measured sound pressure,

po : the reference sound pressure = 2×10^{-5} N/m^2.

. This reading incidates-as required-on A,B,C or D scale, which are networks to simulate the characteristic of the sensitivity of the human car at different frequencies for different sound levels. In many purposes the value of SPL in dB (A) alone is not enough to indicate the characteristic of noise, because the intensity of sound is not uniformly distributed over the frequency band and the ear has a low sensitivity at low frequencies. From point of view of mechanical consideration-treat-

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b-trees as defined in (2). The factor that affects the tree structures is the random procedure to be used in step I of Stage-One. It has been experimentally found that in practice the decision is to be unequally weighted. In this way, the generation of trivial theorems as well as theorems with a very large number of clauses is controlled. In particular a higher probability is given to the addition of clauses to the set C as the set increases.

The second question is whether or not all theorems can be generated. This has been verified by the following observations. In the first place, repeated instances of the same clause are assumed to be represented by different nodes in the refutation tree. This practice allows us to use trees instead of graphs a practice used by others. Second, as previously mentioned there are infinitely many different pairs of clauses that resolve to a given clause. This implies that for the same tree structure we can have infinitely many different theorems. In other words, we have a one to many relation betwen the iterative process of building up the tree and the iterative deductive proof. Using procedure RV generates any one of these many possible proofs. We should however, here mention that these proofs form an infinitely enumerable set of clauses. The present implementation picks anyone of a property subset with unequal probability. The property is to be defined by the user but is syntax independent. That is at this stage the user may decide to have an upper limit on the number of literals, clauses but cannot specify the subset of all solid geometry theorems. Nevertheless, in Stage-Two, the user has the option to weight interpretations to orient the theorems to one specific category of solid geometry for example.

The third and most crucial question is the time and space explosion of the algorithm for Stage-Two in particular.It should be mentioned that space wise the dictionary required would most probably be limited to one sub-category of one application field. The advantage at this point is that accepted theorems are stored both syntacally as well as semantically for the present implementation this allows the interactive use of Stage-Two after having changed the dictionary. Such an attempt may show the relation between different fields of research. Time explosion has been rather primitively limited at that point. It is however, suggested that intelligence be added. The latter requires a more sophisticated dictionary using some intelligent knowledge representation technique whereby combinations of interpretations may be limited. On the other hand, such a technique should be cautiosly used or else the restrictions inforced would never allow the generation of new theorem relations. It is hence concluded that an intelligent theorem discoverer must in fact contain some tedious non-intelligent search. As a compromise it should be intelligently undeterministic, a problem that pops up in different intelligent applications and one may safely say it is still one of the main concerns to researchers in the field of artificial intelligence.

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The dictionary may have literals with 2 argument as Above, On, and Below. The arguments of each are as follows Above and On may have block, block or utencil, utencil or block, furniture or utencil furniture. Similary Below may have block, or utencil, utencil, or furniture, utencil Block may be cube, utencil may be cup or plate and furniture may be table. Notice this is not a sofisticated dictionary. It has only three literal interpretations and three variable interpretations with no functions and some five instant interpretations of specific objects.

After Step I the table formed is as follows

Element	Possible interpretations
Q	Above, below, On
P	Above, below, On
u	block, utencil, furniture
v	block, utencil, furniture
x	block, utencil, furniture
y	block, utencil, furniture
z	block, utencil, furniture
a	cube, cup, plate, table
b	cube, cup, plate, table
c	cube, cup, plate table

Notice that the negation is neglected at that point.

At Step II it will be noticed that most interpretations fit together except for the combination block, furniture and utencil, furniture where a restriction occurs with the Above and On the opposite with the Below. At step III the combinations become something like block Above block implies block Above block, (for the first clause and notice the use of the negation) or the same clause may be block not Above block or block Above block or it may be used with the second clause with the 'and' and so on. Now forming a set of interpretations requires the use of all of the clauses at least once.

The problem is obviously explosive and therefore the implementation used a random restriction for Steps II-IV. The choice of one interpretation from the table formed in step I is either accepted or a second choice is taken for the contradicting literal or argument. This will give fewer combinations to the third step and again a random combination is chosen for the third step and finally the random theorem interpretation is chosen by the last step. Again the probability is affected by user defined options mainly giving weights to the literal interpretations. The present version has an interactive option to enforce the generation of special theorems as a test technique of its successful implementation. So that the theorem may interpret as : -(the first clause) utencil On furniture implies utencil Above furniture.

-(the second clause again using the implication but noting the negation of two literals generates an and. The present implementation does not allow more than two such literal combinations) utencil Above utencil and utencil Above furniture implies utencil Above furniture.

-(the third and fourth clauses and combining them) cup On plate and plate On table.

-(the last clause to complete the set) cup not Above table.

Now choosing the last statement to negate we get the theorem Prove cup Above tabe.

It will be noticed that although the theorem is only a part of the whole set the rest forms the axioms of proof an important part of a newly discovered theorem.

III...CONCLUSION AND FUTURE RECOMMENDATIONS

This paper presents the design and successful implementation of the new algorithm DT for the discovery of theorems. The implementation raises some legal and important questions. The first is the random distribution of the generated theorems. This is two-fold. In stage-one it is syntactically guided and the problem is related to that of generating random

Then the literals would be

L ' " = S (f(x1,j(g1,v),x2,j(x2,a1)),x1,w)

L ' " = S (f(x1,j(g1,b)x2,j(x2,a1)),x1,w)

L " ' = -S(f(x,j(g(x,y),v),y,j(ya)),x,w)

L " ' =-S(f(x1,j(g(x,y),v),y,j(y,a)), x,w)

L " ' =-S(f(x1,j(g(x,y),v),y,j(y,a)),x,w)

At this point, one note is in order before going on to the description of stage two. There are infinitely many different pairs of clauses that resolve to a given clause. The procedure will hence allow any pair of them to be generated with some probability. These are user defined constraints that affect the random choice of number of literals, variables and tree structure. Consequently any theorem can be generated with some probability.

Example theorems that were randomly generated by this stage are the following:

Theorem 1 [T(x), R(y), -T(x) VN(a,b,c), Q(z,c,v), -T(x) V -R(y) V-N(a,f(w),c) V-Q(z,c,u)].

Theorem 2 [-U(z),-X(y) VC(y,x,v), U(g(w)) V(X(Y) VB(w), -C(y,b,v) VK(f(u)), -B(w) VF(t), -K(f(u)) V-I(u,a), -B(w) V-F(c) V-L(w), I(u,g(s)) V(G(w), V(r), L(h(d)) V(-V(k(a)), L(j(u)), -G(w) V-L(j(u))].

Stage-Two. Theorem Interpretation.

Step I. Let L1,L2,...,Lm be the literals found in the theorem generated by Stage One. For each literal select possible intepretations from a given literal variable dictionary and form a table with this information. The dictionary in this context is a user defined terminology giving an interpretation followed by the number of arguments and possible interpretations for each. It should however be noticed that the same terminology may be used with either a different number of arguments or the same arguments or the same argument but with a different interpretation. The dictionary also has a special theorem part where theorems are defined by one or more statements.

Step II. For each clause choose those literal interpretations that give the same variable, term, literal and clause the same interpretation.

Step III. For the set of interpretation of clauses, form several sets of statements interpretations using the following combinations:

(a) assume the 'and' relation between any two clauses.

b for 'or' relation in any clause assume as is -an 'or' relation- or as an implication relation taking into consideration a negation.

Each set must cotain the statements of each of the clauses at least once.

Step IV. For each set of statements formed in step III form a theorem by randomly negating any of the statements This statement is classified by the word 'Prove'

Finally success is decided by comparing each selected theorem interpretation with the built in dictionary or by the aid of the user interactively. The present version is a learning one, automatically adds theorems to the theorem dictionary part if they do not exist using a complete straight forward match.

Example 2. Illustrates the steps of the algorithm at some point of time at Stage Two.

Assume the theorem selected by Stage One is :

-Q (u,v) V P (u,v), -P(x,y) V -P (y,z) V P(x,z), Q(b,a), Q(a,c), -P(b,c).

Using the same principle with the restrictions we return to the clause Cj and get the following table

Literal	Random literals with restriction	substitution
P(x,y)	P(x1,y), P(x1,x2)	x1 (—x, Y(—x2)
Q(u,g(x,y)	Q (u,g1)	g(x,y) (—g1)
-R (h(y), g (a,z))	-R (h(y), g(a,z))	a(--a1

After step 3 we get

C' : P (x1,y), Q(u,g(x,y)) and

C " : P (x1, x2), Q (u,g(x,y)),

-R (h(y), g(a,z)).

For further illustration assume that at **Step 4** procedure for literals goes as follows :

Let S be chosen in a and the random numbers 3,2 and 3 in b and the random number 5 in c then

L' " : S(t,t,t),

L ' " : S (t,t,t),

L " ' = -S (t,t,t)

L" ' = -S(t,t,t)

L " ' = -S(t,t,t)

where L ' = L ' " and L " = L "' substitutions required by step 2 are x1 —x, x2 —y, g1(—g(x,y) and a1 (—a and let the fifth substitution be (—v

Let the outcome of d be as follows :

(t1,x1) = (x1(—x) (1,2), (1), (1)

(t2,x2) = x2(—y) (1), (2), (2,3)

(t3,x3) = g1(—g(x,y)) (1), (1,2), (1,3)

(t4,x4) = (a1(—a) (1), (1), (1,2,3)

(t5,x5) = (b(—v) (1), (2), (1,2)

Then in e we would expect the following

L ' " = S(t1,x3,t4), (t1,)

L ' " = S ((t2,x3,t5), ,)

L " ' = —S (x1,t3,x4,x5)), (x1),)

L " ' = —S((x2,x4,x5), ,)

L " ' = —S ((x2,t3,x4), ,)

The outcome of f would be :

L ' " = S((t1,t2,t3,t4,t5), (t1),)

= S ((x1,x2,g1,a1,v), (x1),)

L ' " = S((t1, t2,x3,t4,x5), (t1),)

= S ((x1, x2, g1, a1, b), (x1),)

L " ' = -S ((x1,x2,t3,x4,x5), (x1),)

= —S((x,y,g(x,y), a,v), (x),)

L " ' = -S ((t1, x2, t3, x4, x5), (x1),)

= —S ((x1,y,g(x,y),a,v)), (x),)

L " ' = —S ((t1,x2,t3,x4,x5), (x1),)

= —S((x,y,g(x,y),a,v), (x),)

At the last step if it assumed that :

-i = 1, Case iii applies

m = 5 (t—) t1, t—) t2, t—) t3, t—) t4 t—) t5)

A— t

t—) t2 (not all of the above rules are exhausted

t--) F (t,t,t,t)--)

F(t1,t,t,t) --)

F (t1,F(t,t), t,t) --)

F (t1,F(t3,t), t,t))--)

F(t1,F(t3,t5),t,t) --)

F(t1,F(t3,t5),t2,t) --)

F(t1,F(t3,t5), t2,F(t2,t))--)

F(t1,F(t3,t5), t2,F(t2,t)) --)

--) f (t1,F(t3,t5),t2,F(t2,t4))

--) f(t1,j(t3,t5), t2,j(t2,t4))

i=2, Case ii applies

t—) t1

A—) t, T—) t1

i=3, Case i applies

A—) t, t—) v and v—)w,

tions. In other words generate a random term using the transformation rules given in step 2 and a random variable provided the pair is not an element of the substitutions required by step 2 nor does it contradict any of them.

d) With each pair of substitution associate three nonempty lists of radom numbers l1, l2, l3 such that j is of li and 1 less than j less than ni.

e) Randomly decide that argument ki of literal L' " " will include term tk if substitution k is associated with the random number k1,k2,k3 such that k1(l1, k2(l2, k3(l3 and argument k1 of literal L ' " " will include variable vk or vice versa.

f) Compare arguments of L ' " (i=1,n2) and randomly decide to add terms or variables of substitutions so that all arguments will involve the same substitutions and do the same with the arguments of L ' " (i =1, n3).

g) For each argument i in L ' " do one of the following :

Case -i if argument i is empty, use the transformation rules listed in step 2 randomly to generate it. Let all arguments i of the ramaining literals be exactly the same.

Case -ii if the argument i has only one element, use the following transformation rule at least once in addition to those listed in step 2 to randomly generate it t —) ti). Let all arguments of the remaining literals be exactly the same. Replace ti by the corresponding element in each literal.

Case -iii if the argument i has elements m ⦣ 1, use the following list of transformation rules at least once in addition to those listed in step 2 to randomly generate it (t —) ti, T —) t2, ..., t — tm). Let all arguments i of the remaining literals be exactly the same. Replace ti by the corresponding element in each literal.

Example 1. Illustrates the steps of the algorithm at some point of time of Stage - One.

Assume clause Cj selected at step II of the algorithm is as follows :

P(x,y) V Q (u,g(x,y)) V
- R(h(y), g (a,z))

procedure RV is then invoked to work as follows :

The terms will be x,y,u,g (x,y), h(y), a, z, and, g(a,z). Then Step 1 may generate the following table :

Term in Cj	Randomly generated variables that may appear in substitution
x	x1, x2
y	y1
u	u1, u2
g(x,y)	g1
h(y)	-
a	a1
z	-
g(a,z)	-

After Step 2, we get the randomly generated liteals. For purpose of illustration assume for literal generation the following example :

a) R is chosen.

b) It is not to be complemented.

c) It will have three arguments i.e. R(A,A,A).

d) A —) t —) v —) x then next
A —) t —) F (t,t) —)g (t,t) —),
g (F(t), t)—) g (f(t), t)—)
g(f(C), t)--)g(f(c),t)--)
g(f(c), V)—)g(f(c),y)
and the last A—)t—) C—)a
hence the literal would be
R(x,g(f(c),y),a),

If the decision is made to add Cj to C, then go to Step III.

Step II. Randomly generate two clauses C' and C'' such that they resolve to give Cj (refer to procedure RV below). Add C' and C'' to S.

Step III. Delete Cj from S.

Step IV. If S is empty terminate; otherwise go to Step I.

Procedure RV. Random Generation of clause C' and C'' that resolve to a given clause C.

Step I. (Determining a possible substitution). Let t1, t2,..., ..., tm be terms in C. For each term ti generate a random number of variables vi 1, vi2... vin. These are variables that could appear in C' or C'' and could have been substituted for by ti in C. Form a table showing this information.

Step 2. For each literal Li in C, randomly generate a random number of literals Li', Li'',... that all unify to Li by replacing some (possibly more) of the terms with one of the variables using the table generated in step 1 as follows:

a) Randomly select a predicate from the set of predicates.

b) Randomly decide whether the literal is to be the complement of the predicate (In this text, - sign will be used to denote complement or negation).

c) Randomly decide on the number of arguments.

d) Generate each argument using the following transformations randomly:

A —) t,
t —) F (t, t,... random number t),
t —) V, t —) C, F —) f,g,h,..,
V —) z,y,x,...,
C —) a,b,c,...
where a clause is the null clause or a disjunction of literals and each literal is in turn, a predicate or its complement denoted by the capital alphabet letters. The arguments of a predicate are called terms. The terms are defined as any of the following:

— a constant denoted by a,b,c...,or

— a variable denoted by z,y,x,... or

— a function of terms where the function name is denoted by f,g,h,..., hence the terms are denoted by f (t,...,) where t is a term and

— nothing else is a term.

Step 3. Randomly assign each newly generated literal to C' or C'' or both.

Step 4. Subject to the constraints indicated in the next sentence, randomly generate one additional literal L' and a random number of its variants ", L'', L''',..., to C' and its complement L'' and a random number of its variants ''', L''', ... to C'' or vice versa. L', L''',... and L'', L''',... must resolve to yield o and the unifier that does this must contain the substitutions required by step 2.

The procedure for generating L' and L'' is as follows:

a) Randomly select a predicate from the set of predicates excluding all those predicates that already exist in C' and C''. Let this be the predicate for L' and its complement for L''.

b) Randomly decide on the number of arguments per literal and the number of variants of L' and the number of variants of L''. Let them be n1, n2 and n3 respectively.

c) Randomly decide on the number of substitutions required to resolve L', L''',... and L'', L''', ... to yield o. The number must be greater or equal to that required by step 2. If the latter is decided, generate the extra pairs of substitu-

AN ALGORITHM FOR NEW THEOREMS

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ABSTRACT

This paper deals with the discovery of new theorems for applications in different fields. The design and implementation of a new algorithm for discovering theorems is presented. The algorithm is a two stage process. Stage one is purely syntactic. A theorem defined in terms of a set of clauses using predicate calculus and verified using the resolution principle is randomly generated. Next in stage two the theorem is semantically translated and checked for originality. Examples for the successful implementation of the algorithm are illustrated. The paper then concludes by recommendations for building an intelligent theorem discoverer.

I. INTRODUCTION

This work deals with the problem of discovering new theorems in different fields. The study gives a detailed description for the design and implementation of of a new algorithm, DT, for the discovery of new theorems. The algorithm recursively goes through two main stages. Stage one is concerned with the selection of a randomly generated theorem and stage two translates the theorem. If the theorem is classified as old it is disregarded and stage one is reinitiated otherwise success is announced.

Section II proceeds to describe Algorithm DT in details with the aid of an example. The work then concludes in Section III by several comments and future recommendations.

II The DT Algorithm

This section starts by the basic definitions of concern to this study. Undefined terms follow the notation in [4].

Definition 1.

A random theorem is defined by the set of clauses that form the terminal nodes of a randomly generated refutation tree.

Definition 2.

A theorem is classified as old if there exist a theorem whose interpretation satisfies the randomly generated theorem.

In Pascal-like language the algorithm is as follows:

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Algorithm DT;
repeat
Stage-One;
Stage - Two,
until success;
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More formally, let S = (C1, C2,..., Ci,...) be the set of clauses generated at some point by Stage-One anl let C=C1, C2,..., Cj,...) be the set of clauses selected at the same point in time to be in the theorem. Initially C and S are empty. As the algorithm proceeds clauses are added to and deleted from S and added to C.

Stage-One. Random Selection of a theorem

Step I. Select a clause from S. (The first time this step is executed, null is selected). Call it Cj Decide by some random procedure whether or not to add Cj to C

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flood hazard areas for the site of Assiut Refinery are then, delineated.

The main conclusions of this study can be summarised as follows :

(1) The storm of 100-years return period with 0.5 hour storm duration is the most critical storm which will cause a considerable damages to the site of Assiut Refinery, Under this critical storm conditions, the water depth is up to 0.35 m in the flood plain areas depending on the hydroulic characteristics of each flooding area.

(2) Two other storm conditions of 100-years return with 1.0 hour storm duration and 75-years return period with 0.5 hour storm duration are found to cause less damage effects on the site of Assiut Refinery compared with the above critical storm.

(3) The other storm conditions, are found cause no hazard damages because of the high rate of soil infilteration in the flood plain areas with respect to these storms intensities.

(4) Under the case of critical storm (i.e., 100-years return period with about 1.65 m/sec are resulted from the flooding size of main channel that intersects the southern border of Assiut Refinery, is the most critical flooding conditions. A water of 0.35 m with a flow velocity of about 1.65 m/sec are resulted from this critical storm. The water volume that could reach Assiut Refinery site through the main channel is found tobe about 141.000m^3. In addition, the volume of water that could reach Assiut Refinery site through the minor channel and other neighbouring channels is expected to be 159.000m^3 under the critical storm

A prelimenary study has been made to investigate the flood protection for Assuit Refinery site. Different engineering solutions of flood damage protections may be proposed. However, the different engineering solutions should be precisely investigated and compared. Thus, it is recommended to evaluate the feasibility of each solution.

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The critical discharge of the main channel is 0.25 of the peak discharge of watersheds B and the peak discharge of zone C.

The water depth of the main channel measured from the lowest point in Section 2-2 is related to the channel width, cross-sectional area and water volume. In addition, the water depth of the minor channel is also related to these quantities. These relationships are used in evaluating the water depths and velocities under the selected flooding conditions. Moreover, a relationship between the water depth and the discharge of the main channel was developed using Manning's formula to find the water depths and velocities of these flooding conditions as presented in Table (3). The corresponding water surface widths are evaluated for the main channel. Applying the same procedure on the other zones gives the water depths and velocities as presented in Table (3) and (4). Therefore the risk zone maps can be inferred to find the sizes of flash floods due to different storm events as shown in Fig. (9). using Tables (3) and (4). The flash flood of 100-yr return period with 0.5hr duration is the most hazardous one because the water depth and flow velocity are 0.35 m and 1.65 m/sec, respectively. The corresponding water surface width of the main channel is about 150m due to the same storm conditions.

4. CONCLUSIONS AND RECOMMENDATIONS.

As a summary of this study, analysis of aerial photographs for the Mankabad area, where the site of Assiut Refinery is located, is made. The different watersheds that may cause flood damage to the Assiut Refinery are identified. Results of fields trip and survey to these watersheds are provided. The geological description of Assiut region is also illustrated. Analysis of rainfall data at the Assiut meteorological station is presented. Estimation of the critical storm depths of various return periods are determined



Fig. (9) Flood Hazard Map For 100-yr Return Period and 0.5hr Duration

Table (4) Dimensions of water Cross-Sections of watersheds E and D in the Flood Plain area

Region / Parameter	Watershed E 100-yr 0.5-hr	Watershed E 100-yr 1.0-hr	Watershed E 75-yr 0.5-hr	Watershed D 100-yr 0.5-hr	Watershed D 100-yr 1.0-hr	Watershed D 75-yr 0.5-hr
Discharge (m^3/sec)	30.82	16.94	14.42	142.40	77.28	68.82
Cross-Sectional Area (m^2)	22.50	15.00	13.50	85.00	60.00	55.00
Total width (m)	150	150	150	500	500	500
Water Depth (m)	0.15	0.10	0.09	0.17	0.12	0.11
Water Velocity (m/sec)	1.38	1.13	1.07	1.68	1.29	1.25

and discussed to evaluate the critical discharges that cause floods in this area.

Geomorpholobical mathematical model for the Instantanous Unit Hydrograph (IUH) and discharge hydrograph of a third order as well as a fourth order watershed is developed and presented. This geomorphological model relates, watershed for these watersheds under different storm depths and durations. The total surface-runoff as well as peak discharge of these watersheds are discussed. The flood zone maps analysis for the areas southern Assiut Refinery are presented. Thus, the

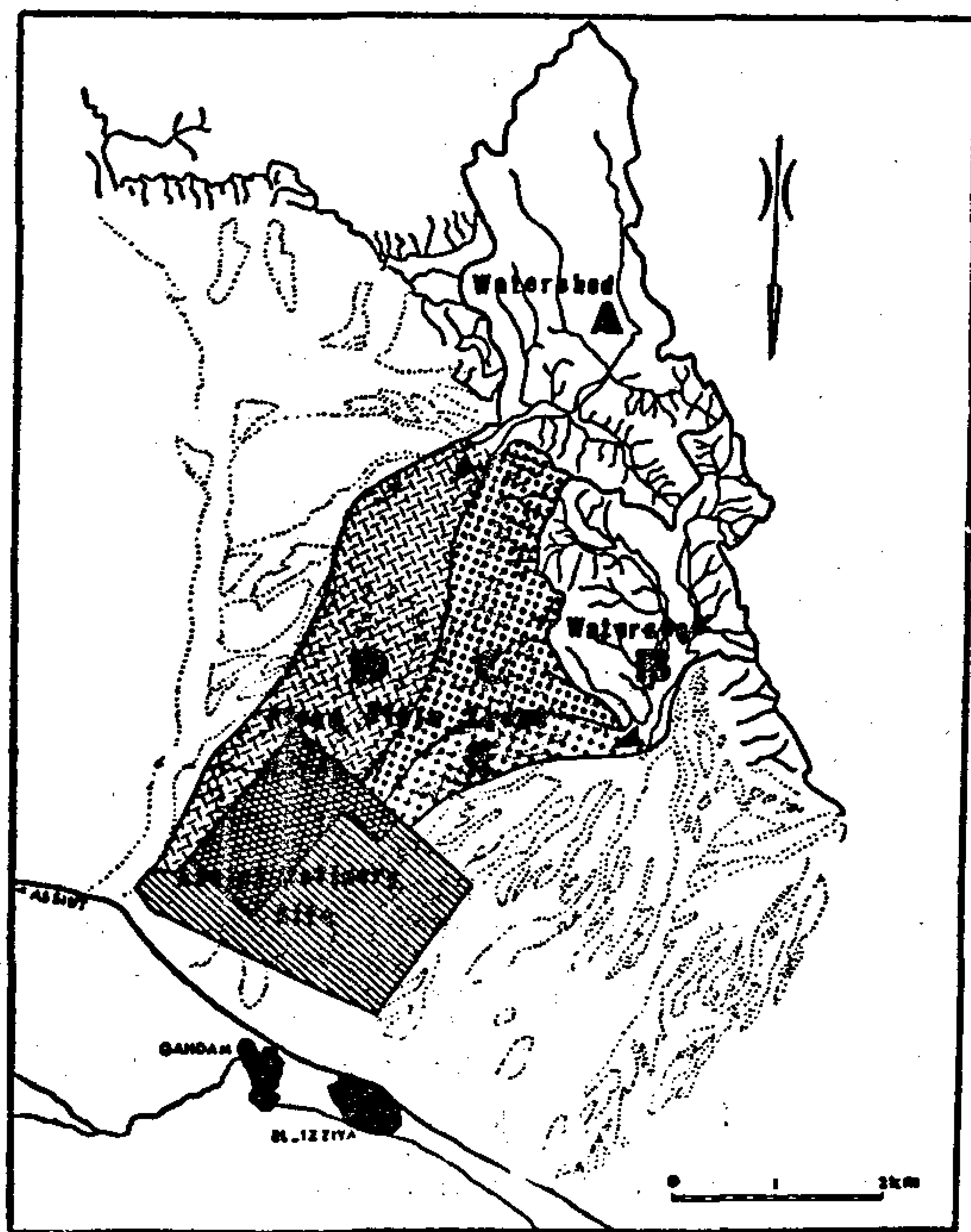


Fig. (8) Critical Flood Plain Zones (D, C & E)

Table (2) Surface characteristics of Flood plain zones

Zone	C	D	E
Average Slope (%)	1. 5	2. 0	3. 0
Average length (Km)	2.60	3.20	2.27
Surface Area (Km²)	2.60	3.40	1.07
Average Infiltration Rate (Cm/hr)	3.25	3.00	3.50
Time Lag* (hr)	1 84	1.87	1.16
Flooding Area (Km²)	1.17	1.87	0.52
Peak Discharge (m³/sec):			
100-yr & 0.5 - hr	10.32	14.20	6.70
100-yr & 1.0 - hr	6.00	8.50	3.14
75-yr & 0.5 - hr	3.54	4.72	2.36

* Curve Number = 72

Table (3) Dimentions of water Cross-Sections of the Main Channel and Watershed in the Flood Plain Area

Region / Parameter	Main Channel			Watershed C		
	100-yr 0 5-hr	100-yr 1.0-hr	75-yr 0.5-hr	100-yr 0.5-hr	100-yr 1.0-hr	75-yr 0 5-hr
Discharge (m³/sec)	41.14	22 94	17.96	10.32	6.00	3.54
Cross-Sectional Area (m²)	25 00	18.00	15.00	10 32	6.00	3.54
Total width (m)	150	120	110	115	67	39
Water Depth (m)	0 35	0.28	0.26	0.09	0 09	0 09
Water Velocity (m/sec)	1 65	1 27	1.20	1.00	1.00	1.00

length. The time lags of the three zones are shown in Table (2). As time lag decreases, the peak discharge of the overland flow is expected to increase. Another factor affecting the peak discharge is the infiltration rate of the soil. The infiltrated water depth of each storm was substracted from the actual storm depth to obtain the effective rainfall (rainfall excess). Finally, the peak discharge of each zone was estimated considering the time lag and effective storm depth. Tables (3) and (4) show the peak discharges of each zone under different flooding conditions. These flooding conditions are 100-yr return period with 0.5-hr duration; 100-yr return period with 1.0-hr duration; and 75-yr return period with 0.5 hr duration. The other flooding conditions have less effects because either the infiltration rate exceeds the actual storm or the effective storm depth has harmless effects. The values of peak discharges of the three zones are relatively small compared to that of the watersheds A and B. However, these peak discharges are taken into account in evaluating the sizes of risk zones as explained in the following section.

Risk Zones Mapping :

Delineation of the risk zones maps requires evaluation of the water depths and flow velocities which depend mainly on the stream characteristics. These characteristics are the surface roughness, bed slops, and discharge. There are two channels (called here main and minor channels) pouring their discharges at about 1.0 and 0.5 hydrological response to watershed geomorphology, and is similar to that recently proposed by Gupta et al., 1980. The geomorphological model is used in determining IUH's and discharge hydrographs of the different watersheds that may affect the site of Assiut Refinery. The IUH's and discharge hydrographs are presented km respectively, from the southern eastern edge of the Assiut Refinery.

running parallel to the south west periphery of the proposed site of the refinery The distances between these two proflies 1-1, 2-2, and the periphery are 1400m, and 400 m, respectively. These two profiles are crossing the two main wadies in the low land area and have lengths of 3217 m and 3260 m, respectively The longitudinal profiles 3-3, 4-4 and 5-5 are approximately parallel run and the NE. SW direction (approximately perpendicular to the south west periphery of the factory).

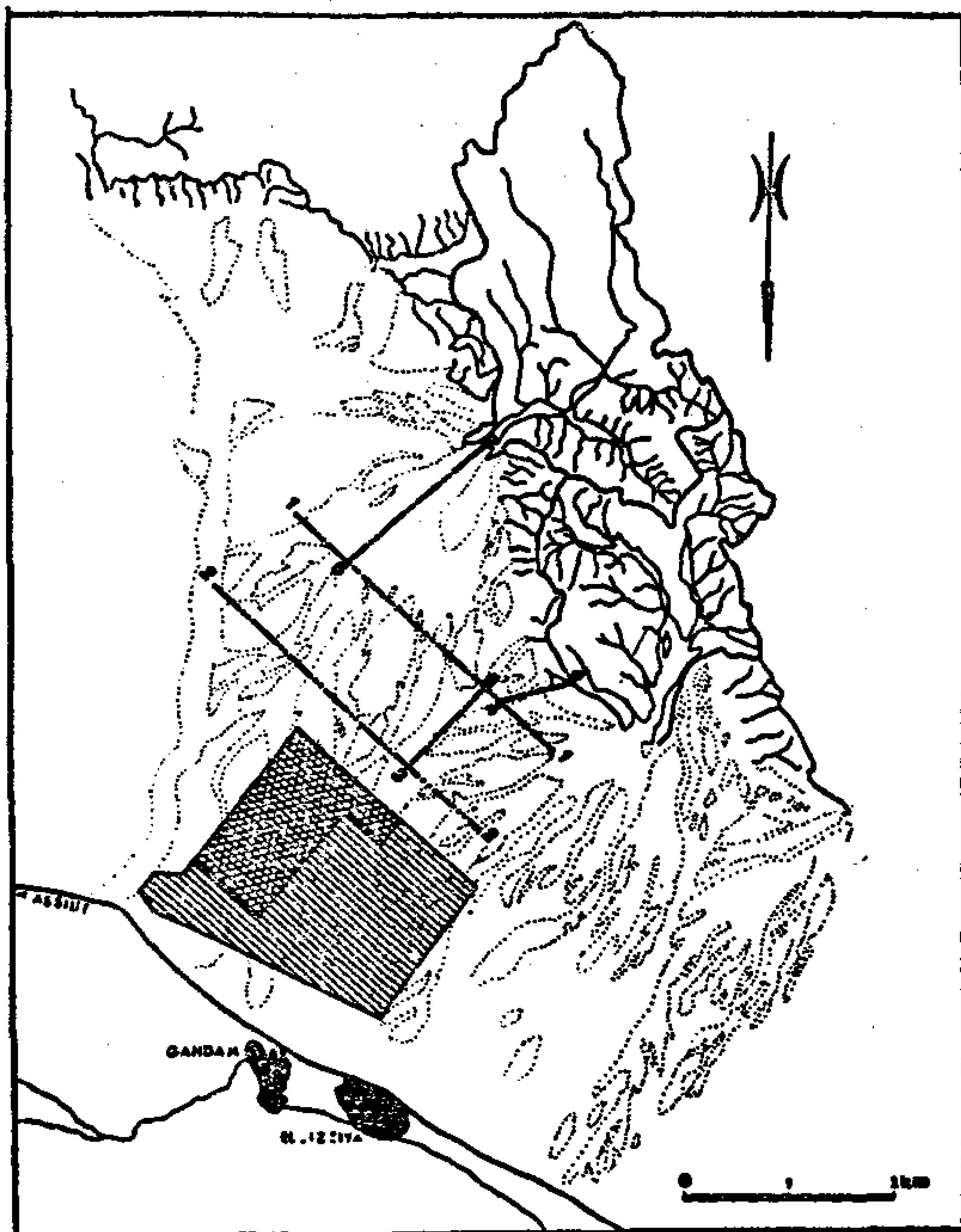


Fig. (7) Axes of Longitudinal and Trans verse Cross-sections and the Directions of

Profile 3-3 has a length of 1000 m and connects the two profiles 1-1 and 2-2 and runs in the northern main wadi. Profiles 4-4 and 5-5 having lengths of 800 and 2272 m, respectively and connect the profile 1-1 by the two outlets of the two main watersheds A and B through the two main wadies. Two transversal profiles were carried out at the outlet of each of the two watersheds.

Infiltration Tests :

The infiltration capacity of the soil was measured using a flooding type infiltrometer.The infiltrometer was driven 5 cm into the soil. The rate at which water must be applied to maintain a constant head of about 5 cm was taken to represent the infiltration rate. Infiltration capacity was measured at 5-minutes intervals for the first 15 minltes and then at 15-minutes intervals for the remainder of the test which lasted for 60 minutes.

The mean capacity for each run was computed after using an appropriate correction factor.

Mechanical Sieve Analysis:

Two representative samples were taken from the outlets of the two watersheds A and B. The samples were taken from the locations in which the infiltration tests were carried out. The two samples were mechanically analyzed for the following fractions : 31.5, 16.0, 4.0, 2.0, 0.84, 0.42, 0.177, 0.105 and 0.074 mm.

3.2 Flood Hazard Zones :

The flood area between the rocky cliffs and the refinery site C,D, and E. as shwon in Fig. (8), these zones receive major parts of water flows from the two main watersheds A and B. besides the rainfall excess of these zones. The zones D and E are receiving approximately 0.7 and 0.25 of the watersheds A and B, respectively. Meanwhile, the overland flow of the three zones due to the rainfall excess can be estimated by the Soil Conservation Service (SCS) method. Furthermore, the water depths and flow velocities in the streams of the plain areas can also be obtained by applying Manning's formula that considers the soil type and stream slope.

In the present study, the flooding conditions are studied and mapping the risk zones that made according to the water surface width of each zone. The criterion of hazardous flood is either a water depth exceeding 0.3m or a water velocity exceeding 1.0 m/sec.

Estimation of Flood Plain Overland Flows:

The SCS method (Vissman, et al., 1977) is utilized to calculate the peak flows of the three zones. C, D, and E. The time lag of each zone was estimated as a function of the soil type and slope, and stream

such cases. As shown in these figures, an increase in the storm duration will result a decrease in the peak discharge. It also causes the peak discharge to continue for longer period. Generally, the watershed "A" is more hazardous than watershed "B". The surface-runoff of a watershed due to a certain storm depth represents the area under the discharge hydrograph of this watershed.

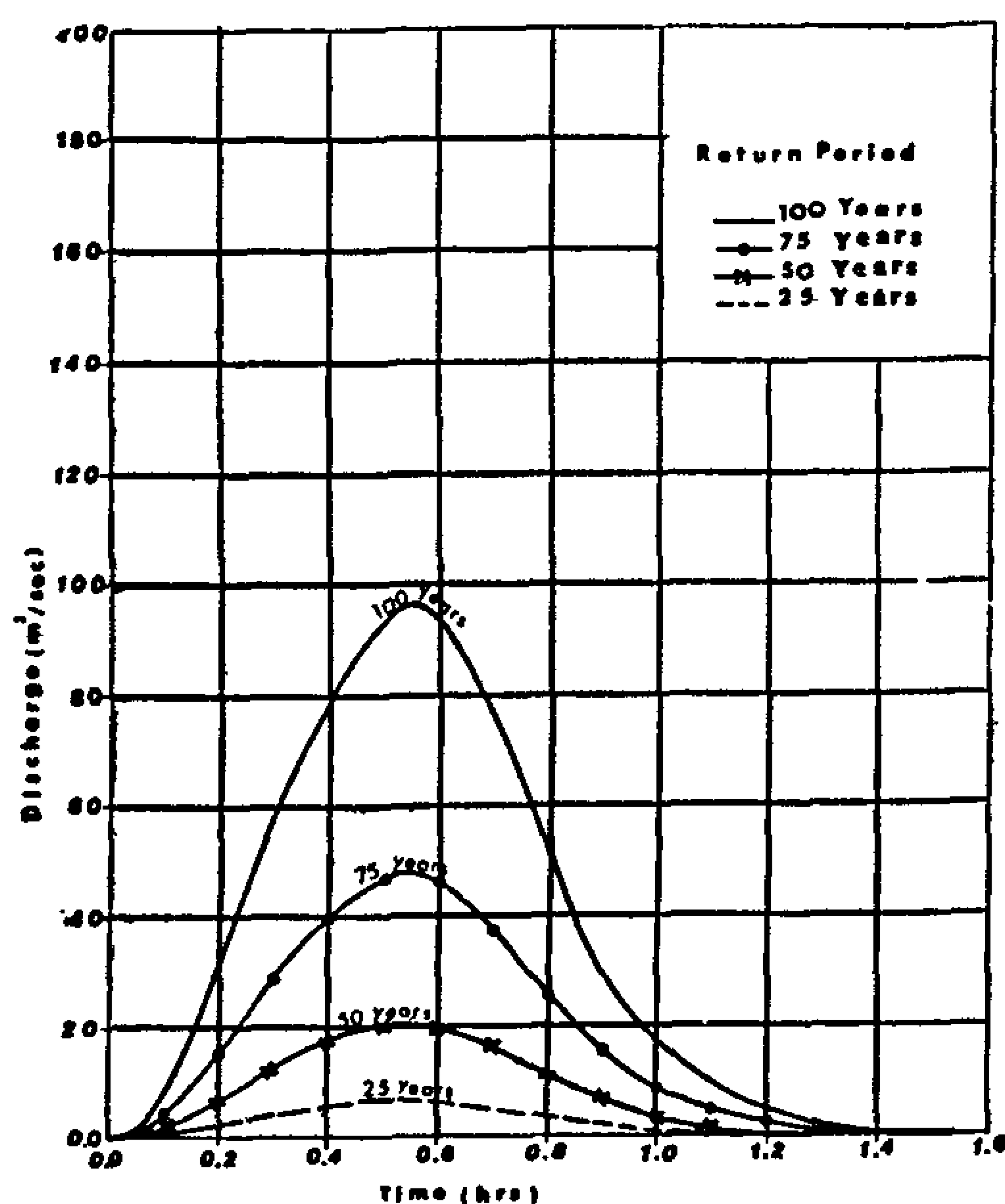


Fig. (5) Discharge Hydrograph of Water shed «A» Due to a Storm of 0.5hr-Duration for Different Return Periods

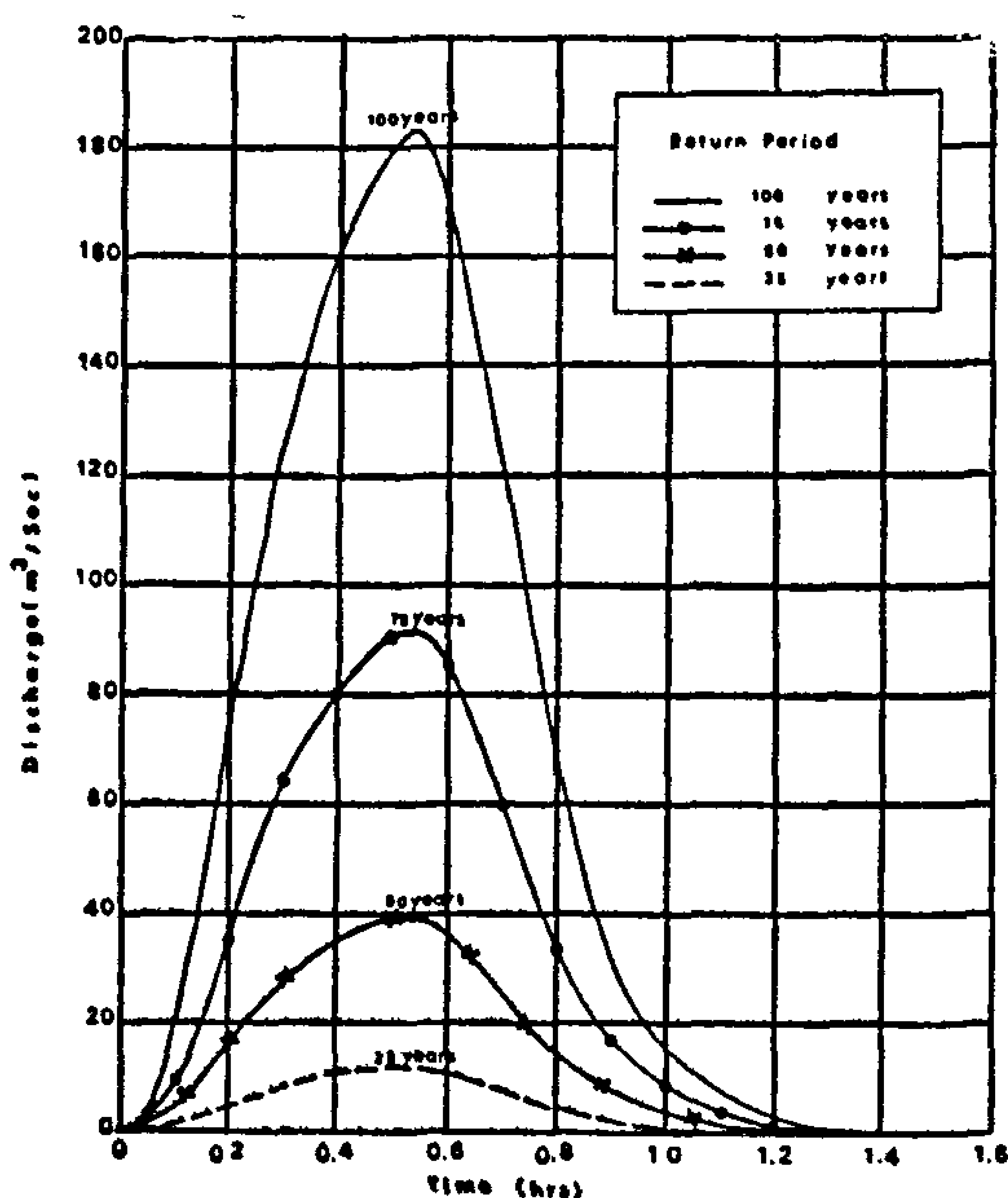


Fig. (6) Discharge Hydrograph of Watershed «B» Due to a Storm of 0.5 hd-Duration for different Return Periods

3. RISK ZONES MAPPING ANALYSIS

Risk zone mapping is a method of determining the flooding areas and water depths due to a storm event. The declination of such areas is important in flood analysis to protect a certain site in the area. Therefore, there is a need to study the flooding conditions in the plains southern of the Assiut Refinery site and to propose a suitable protection system to reduce the flood damages. The surface runoff reaching Assiut Refinery site is due to the overland flow from the flood plain areas south of the site in addition to the runoff from the watersheds in the southern surrounding cliffs, mainly from the two watersheds «A» and «B». The surface runoff from a watershed is represented as the area under the discharge hydrograph of this watershed.

3.1 Field Measurements :

This section covers the results of the surveying, hydrological, and geomorphological field studies carried out on an area of about 9 km^2 to the southern western part of the proposed site of Assiut Refinery. The aims of study are to carry out the following :

i Five longitudinal topographical profiles of about 11 km in length as shown in Fig. (7).

ii Four transversal topographical profiles at the outlets of watersheds "A" and "B"

ii Collecting of representative samples of the soils for laboratory sieve analysis.

iv Conducting two infiltration tests near the outlets of watersheds "A" and "B".

Field Survey :

As previously mentioned, the survey work aims to carrying out 5 longitudinal topographical profiles and 4 transversal profiles at the outlets of the two main watersheds. The location of the 5 longitudinal profiles are shown in Fig. (7). The two profiles, 1-1 and 2-2, are

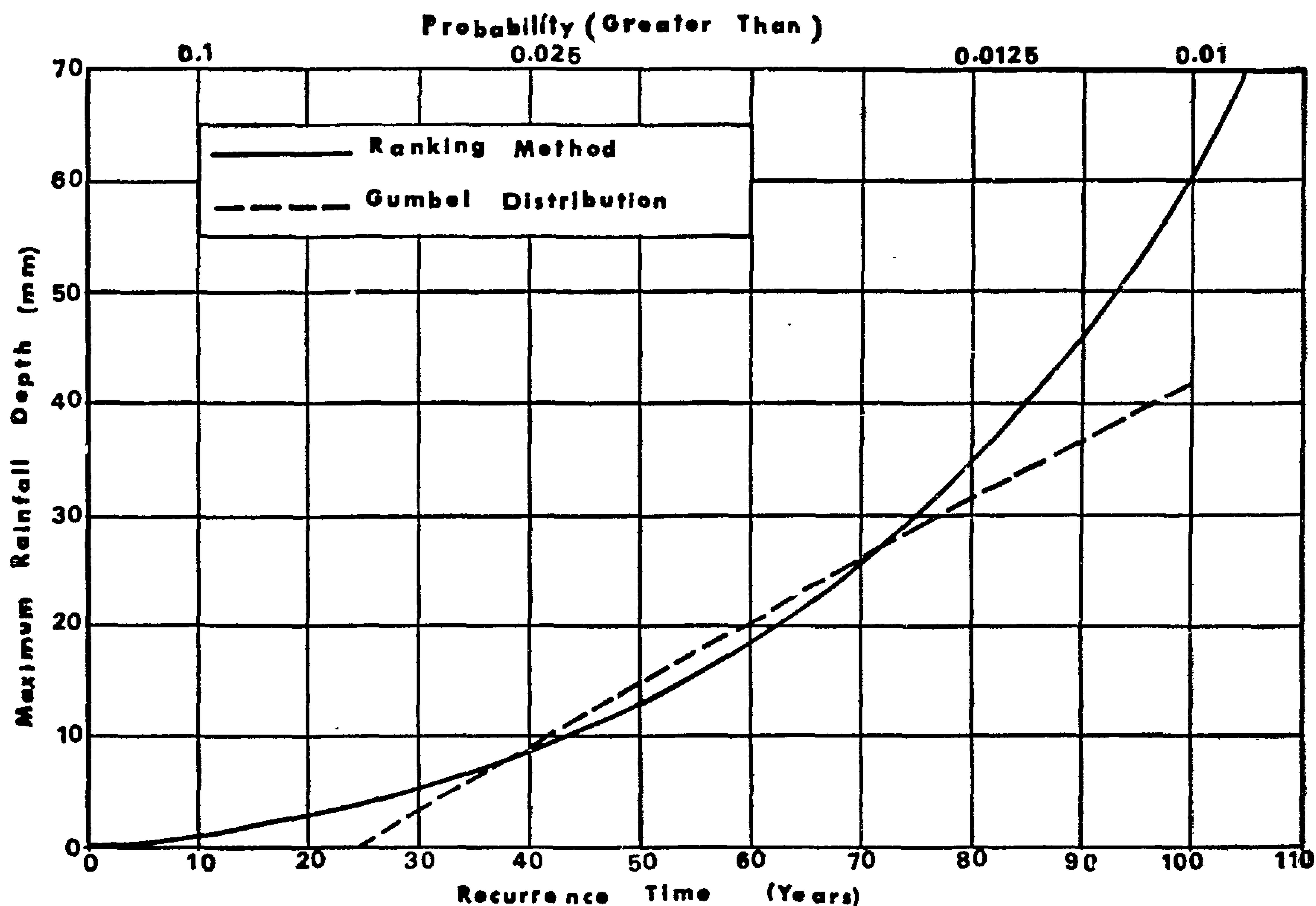


Fig. (4) Recurrence Time of the Maximum Rainfall Depth

Table (1) The Rainfall Intensities of Different Return Periods and Duration at Assiut Meteorological Station.

Return Period (years)	Rainfall Depth (cm)	Rainfall Intensity (cm/hr) 0.5 hr (Duration)	1.0 hr (Duration)	1.5 hrs (Duration)	2.0 hrs (Duration)
100	6.0	12.00	6.00	4.00	3.00
75	3.0	6.00	3.00	2.00	1.50
50	1.3	2.60	1.30	0.87	0.65
25	0.4	0.80	0.40	0.27	0.20

IUH'S and Discharge Hydrographs of Watersheds «A» «B»:

The geomorphological mathematical model is applied here for both watersheds «A» and «B» in order to obtain the hydrologic response of these watersheds. The IUH's and discharge hydrograph of these watersheds are evaluated with different combinations of storm depths and durations. The storm depths of 100,75,50, and 25 years return periods with different storm durations of 0.5, 1.0, 1.5, and 2.0, hours are used. The IUH's of watersheds «A» and $B» discharge hydrographs of these watersheds under different combinations of storm depths and durations are simulated. Figures (5) and (6) show

years. However, the rainfall depths of various return periods will be studied in order to evaluate the peak flows of water sheds under different flooding conditions. These return periods are 100,75,50 and 25 years. Moreover, each return period is subjected to many durations 0.5 hr, 1.0 hr, 1.5 hr, and 2.0 hrs.

The region of Assiut is characterized by an arid climate. However, the region may receive rainy storms that cause flooding damages in different sites. Therefore, it is necessary to evaluate the critical storm depth and its effect on the proposed site of Assiut Refinery. The monthly records of rainfall at the Assiut meteorological station were obtained from the Nile Basin suplements covering the period from (1953-1981). The largest storm depth over about 60 years was also obtained.

Rainy days (storms) for each month were given. From these records, the maximum storm depth in one year can be evaluated. These records have been used to find the design storm depth for the Mankabad area where the Assiut Refinery will be located. The reason of using these available data is that the Assiut meteorological stations is the closest meteorological station to the area of study. The largest value of maximum rainfall depth of one storm is 20 mm during the last 60 years (1924-1984). This value is used along with the available records to obtain the curve of return period of any storm depth. The basis of determining the return period curve is to study two different probabilistic approaches and select the appropriate one for the area of study.

The first approach is to evaluate the parameters of the Gumbel probability distribution using two points on the curve. The reason of using this distribution is that the maximum yearly storm depths follow the Gumble distribution. This distribution has two parameters. Extrapolating the Gumble probability distribution for return period of 100 years gives the critical storm depth of 42 mm that may be repeated every 100 years. As shown in Fig. (4), the small values of rainfall depth were not considered in this probabilistic model.

The second approach is to use Weibul method of ranking. The largest value of storm depth in 29 years has the first rank, etc. The probability of a certain rainfall depth or more is then calculated. The corresponding return period (in years) is the inverse of this probability, Benjamen and Cornell (1970). As shown in Fig. (4), most of records of rainfall depth indicate that Assiut region is dry. In order to improve the accuracy of the return period of any storm depth, the maximum storm depth over 60 years (20 mm) is plotted on the same return period curve. Extrapolating this curve gives the critical storm depth that probably occurs every 100 years. This depth is 60 mm as shown in Fig. (4).

The ranking approach is the most convenint one in dry conditions because it shows the actual probabilistic. On the other hand, Gumbel distribution does not fit the actual measurements, especially the small value of rainfall depths. Therefore, the ranking approach is considered in evaluating the return periods of different rainfall depths. Table (1) shows the values of storm depths and the corresponding return periods. These values are obtained from the ranking approach in Fig. (4). Moreover, the values of rainfall intensities are calculated for various durations. These values will be used in the Geomorphological watershed model applications in order to obtain the corresponding discharge hydrographs and peak discharges for each watershed,

2.4 The Watershed Hydrological Response

The estimation of surface runoff for a given watershed (basin) requires informations about the storm (rainfall) events and corresponding amounts of outflow discharge at the basin outlet. With these information a relationship between rainfall event (intensity and duration) and outflow discharge may be obtained. With such relationship and for any rainfall event, the corresponding outflow discharge could be estimated. These type of basine are called gauged basins. For ungauged basin, where the records of the past outflow discharge are not available the estimation of surface runoff could be obtained using computerized mathematical models.

Recently, methodologies have been proposed to relate basin response to blasin-geomorphology (Rodriguez Iturbe and Valdes, 1979, Gupta et al., 1980), which are useful in the estimation of the hydrologic response in regions with sparse or no data. The Instantaneous Unit Hydrograph (IUH) of a given basin is expressed as a function of the geomorphology quantified by the Horton's numbers and the response of individual channels, assumed to behave like linear reservoirs. This IUH is defined as the Geomorphological Instantaneous Unit Hydrograph (G IUH). A detailed description about Geomorphological IUH is given by Gupta et al., 1980.

Therefore, a computer mathematical model have been developed to compute the IUH of a basin, Imam et al., (1985). This model depends upon the geomorphological parameters of the basin as well as the average flow velocity throughout the basin. Furthermore, this mathematical model is able to calculate the discharge hydrograph of basin when the storm event excess (rainfall intensity and storm duration) is introduced. The applications of the developed model for both watersheds "A" and "B" are presented in the following slection.

Geomorphological Quantitative Analysis :

The available aerial photographs are used to determined the geomorphological quantitative parameters (R_B R_A , and R_L) of both the watersheds «A» and "B". A stereoscope is used in analysing these aerial photographs. The streams of each watershed are precisely identified For each watershed, the number of each stream order is counted and the bifurcation ratio R_B is determined. The drainage areas of these streams are accurately determined.

A planimeter is used to measure the size of these drainage areas, while a measuring wheel is used to measure the lengths of each stream. The average value of drainage area of each stream order is calculated, and the area ratio R_A is computed for each watershed. The average length stream order is calculated, and the length ratio R_L for each watershed is also computed.

In order to estimate the average slope of each watershed, two cross-sections of the main stream of each watershed are surveyed. By substituting the average slope value of each watershed in Manning's formula with Manning's coefficient n equal to 0.025, the average water velocity V is then calculated for each watershed.

Rainfall Analysis of Assiut Region :

Estimation of the critical storm depth is necessary for watershed analysis and flood management. In the study the design storm depth is evaluated according to a certain return period. The storm depth of 100 - years return period is considered as the critical rainfall depth. It is defined as the maximum storm depth of rainfall that may occurs in a 100-

2.3 Identification and Geomorphological Description of Watersheds Affecting The Proposed Site of Assiut Refinery

In order to identify and describe the streams and their drainage areas (watersheds) that may cause flood damage to the site of Assiut Refinery, it is important to describe the geomorphology of a large area covering the site of interest and its surrounding area. The appropriate survey maps and/or aerial photographs are usually used in such studies. Unfortunately, a survey map of 1 : 25,000 is only available for the Mankabad area where the proposed site of Assiut Refinery is located. On this map, a large number of watersheds (streams and their drainage system) can not be identified Furthermore, a large area including the site of Assiut Refinery is not surveyed. It is concluded, therefore, that the available survey map is not appropriate for such job. Due to the shortage of surveying maps for the Mankabad aera efforts have been concentrated towards using the available aerial photographs. In addition, field trips to the site of Assiut Refinery are also conducted in order to identify and describe its surrounding area.

The available aerial photographs for the Mankabad area are obtained from the Egyptian Military Survey Department. A stereoscope is used to analyze these aerial photographs for all the Mankabad area.

In general, the Mankabad area, where the Assiut Refinery is located, is bounded by a mountainous nature with a number of watersheds that may cause flash flood and, thereby, extensive damage to the neighbour areas. These Floods are created by the rain falling on these watersheds. The severities of these floods depend upon the rainfall intensities and durations as well as the size of watershed and its slope. A watershed of small size but with steep slope is more hazardous compared to a bigger watershed with mild slope. Another factor that may affect the severity of the flood is the infiltration rate inside the watershed. This infiltration rate is depending mainly upon the soil type of watershed. A water shed with low infiltration rlate is more hazardous than a watershed with high infiltration rate. Among these watersheds in Makabad area having both steep slops and very low infiltration rate are the watersheds "A" and "B" which draining the major parts of their water to the site of Assiut Refinery as shown in Fig. (3). The surface runoffs (flash floods) of these watersheds "A" and "B" are naturally collected in a number of streams (flood plain region) which affect the site of Assiut Refinery. The watershed "A" is a third order basin with a drainage area of 5.9 km^2. The watershed "B" is a fourth order basin with a drainage area of 3.3 km^2. The soil type of these two watersheds are of limestone as identified from the field observations. As the limestones are impermeable, the infilteration rate is very low with a negligable quantity.

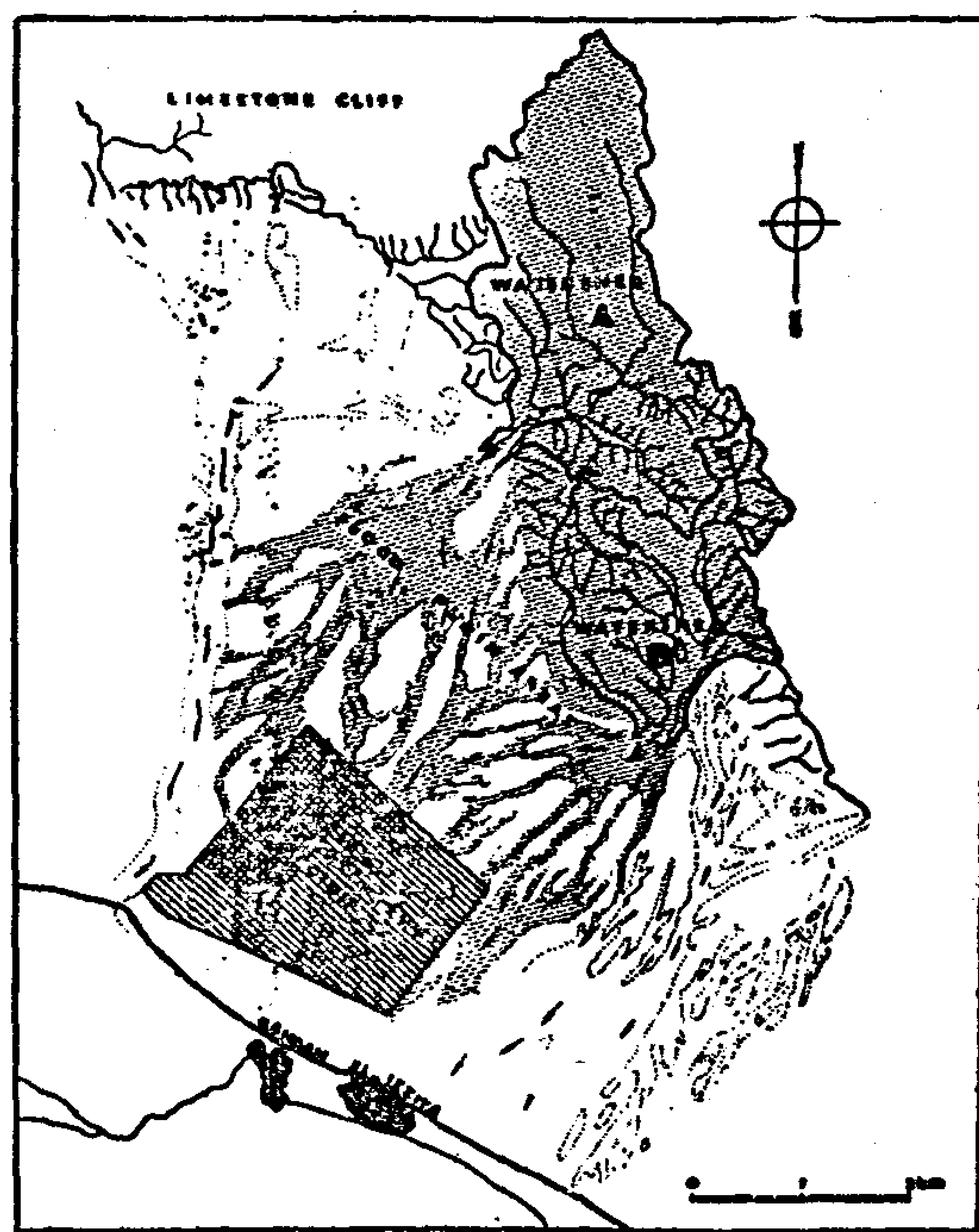
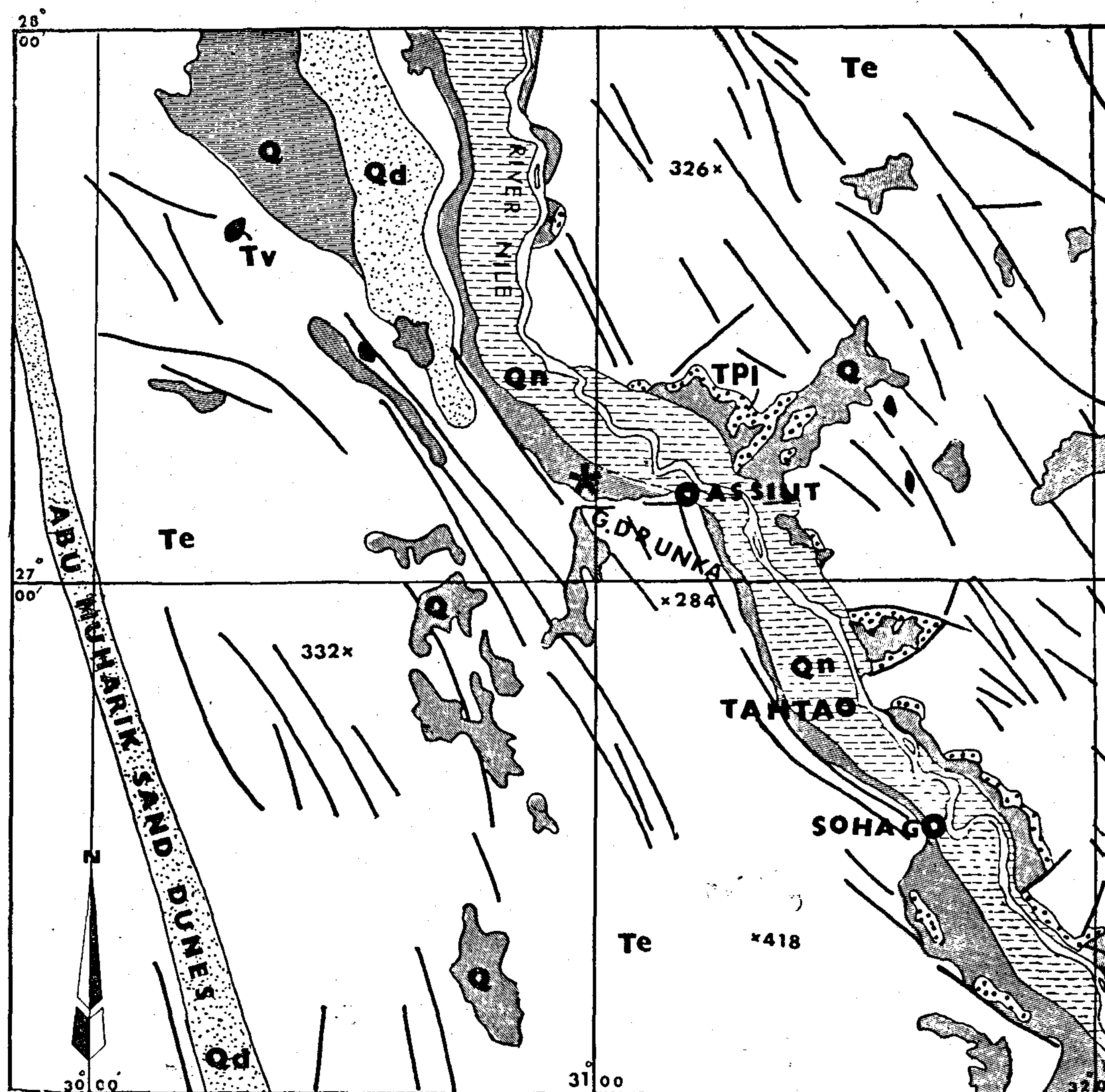


Fig. (3) Drainage System of Area of Study



Qd Sand Dunes

Qn Nile Deposits (Cultivated)

Q Undivided Quaternary

Tpl Pliocene (Marine beds of Nile Vally)

Te Eocene (Thick Limestone with Chert and minor Clay beds)

Fault

Assiut Refinery

Main Cities

Tv Extrusive Rocks

Fig. (2) Geological Map of Assiut Region

Generally, Assiut region (excluding the Pliocene and later sledimments in the Nile Valley) is occupied by Eocene limestone rocks dipping almost in a northerly direction throughout the region. The surface of the limestone cliffs on the western side of the Nile Valley in Assiut region are cut by numerous watersheds, most of them are of small sizes running towards the Nile. On the other hand, the Eocene rocks in the eastern side of the Nile Valley are giving place to dusty plains over which run larger streams towards the Nile such as Wadi Assiut.

Refinery the risk zone areas of Assiut Refinery site subjected to these flash floods can be delineated.

The main goal of this study is to indentify the risk zone areas of Assiut Refinery site which are subjected to flash floods. The objectives of this study may be summarised as follows : i) to determine the geomophological characteristics of the different watersheds in Mankabad area (where the Assiut Refinery is located) which may cause flash floods to the site of Assiut Refinery; ii) to estimate the critical storm depths that may fall on Mankabad area from the available data at the nearby meteorological stations; iii) to apply a developed geomorphological mathematical model to the different watersheds in order to evaluate the hydrologic response of these watersheds subjected to different storm depths (i.e. different return periods and storm durations); and iv) to indentify the risk zone area of Assiut Refinery site subjected to flash floods.

The above objectives may be achieved in the following sections :

2. HYDRO-MORPHOLOGICAL ANALYSIS

2.1 Location of Assiut Refinery

The proposed site of Assiut Refinery is located at Mankabad area west of the Nile Valley, in Assiut Governorate. The Assiut Refinery location is at a distance of about 20 kilometers to the west of Assiut City and nearby Bni-adi and El-Izziya villages as shown in Fig. (1). It lies at about latitude 27° 12 N and longitude 30°59 E with an average level of about 87 meter above S.W.L.

2.2 Geological Description of Assiut Region:

The Pliocene and latter Quaternary sediments of the Nile Valley in Assiut region are bounded by faulted cliffs of Eocene limestone rocks, as shown in the geological map, Fig. (2) Gebel Drunka, which is situated to the southwest of Assiut (approximate latitude 27° 08 N and longitude 31° 10 E), is one of the famous, cliffs which bound the Nile Valley from the west. The proposed site of Assiut Refinery (south of Gahdam village in Assiut region) is located at the boundary of the cultivated deposits of the Nile Valley, in an area covered with Quaternary clastic sediments, and at distance of about four kilometers from the Eocene limestone cliffs. The Eocene limestone of Gebel Drunka is influenced, as well as the areas and cliffs on both sides of the Nile Valley in Assiut region, by many faults. The majority of them are parallel to the direction of Suez Gulf. These faults are indicating the trough - fault origin of the Nile, which was eroded on a line of faulting and rifting. The most pronounced fault that borders the western side of the Nile Valley in Assiut region is that extends from Sohag to Assiut in a north west direction. Another fault can be detected in the eocene limestone and extends from Assiut in a west direction and passing at a distance about five kilometers south of Assiut Refinery site.

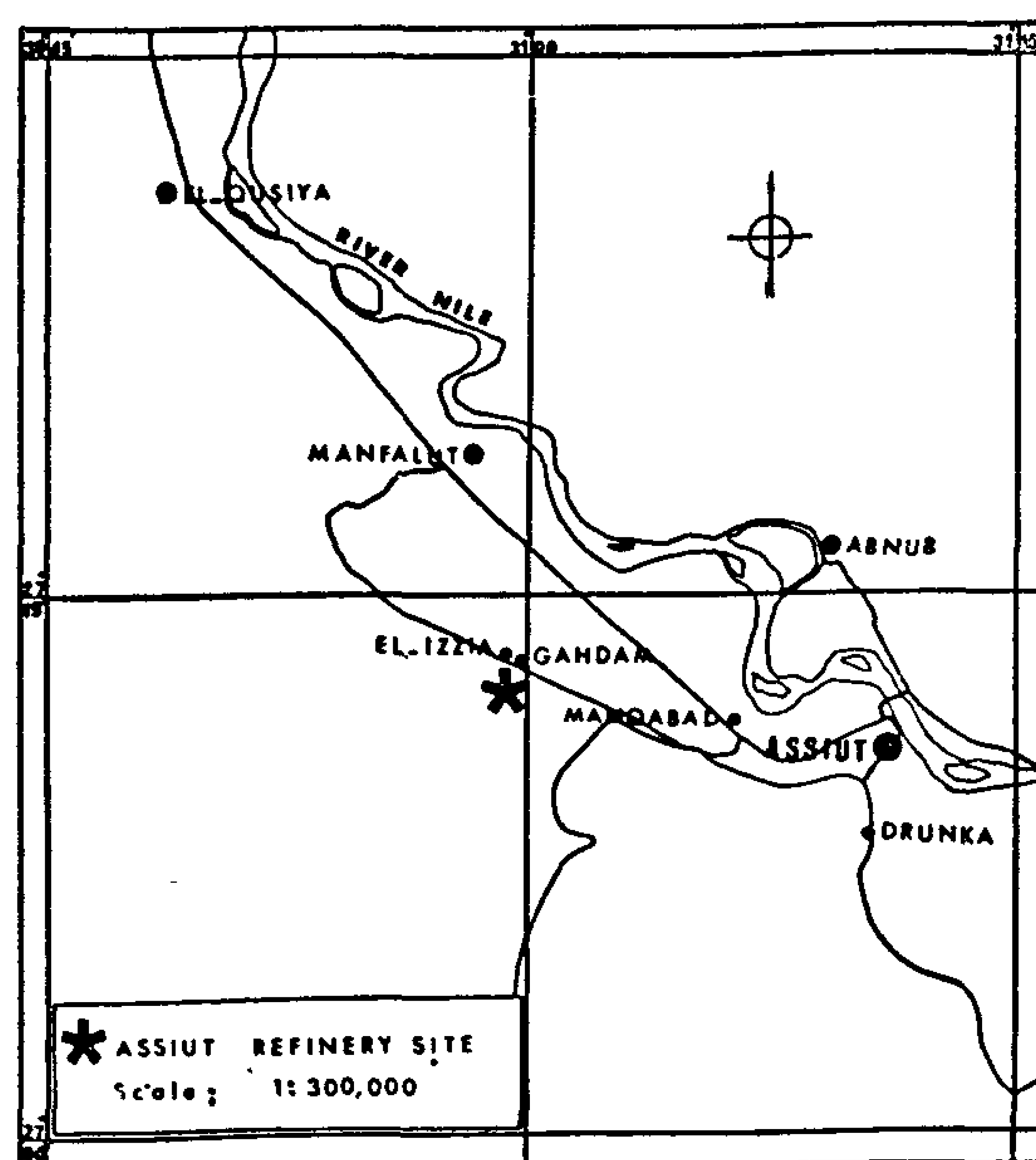


Fig. (1) Location of Assiut Refinery

HYDRO-MORPHOLOGICAL ANALYSIS FOR ASSIUT REFINERY SITE AND ITS VICINITY

Dr. Reda M. El-Damak*

1. INTRODUCTION

In the last decade, the areas close to the Nile valley in upper Egypt have been subjected to occasional flash floods that caused a considerable amount of damages. For instant, the flood of October 1979 has created extensive damages to infrastructures, social institutions, and agricultural production, Mobarek et al., (1981 a,b). Most of these damages have been located in four Governorates namely : Aswan, Quena, Sohag, and the Red Sea, The flash flood problems become more frequent in the Upper Egypt and, therefore, it causes serious problems to the future development in Upper Egypt.

The flash floods are mainly created by the rain falling on areas that have a number of watersheds. At the outlet of these watersheds, the flow of water(flood) is collected in one stream or a number of streams and causing flood damages to the nearby plain areas. The severity of these floods (hydrologic responses of watersheds) depends upon storm (rainfall) depth, storm duration, geomorphological characteristics of watersheds, size (drainge area) of watersheds, and slope of watersheds. Another factor that may affect the severity of these floods is the infiltration rate inside the watershed. The infiltration rate depends upon the soil type of watershed.

The site of Assiut Refinery is located at Mankabad area west of the Nile valley, in Assiut Governorate. The Assiut Refinery is one of the major economical developmental project in Upper Egypt. It is known that Mankabad area has a number of watersheds that may cause flash floods to the nearby plain areas. Among these plain areas that may be subjected to such flash floods is the site of Assiut Refinery. Tterefore, the estimation of flash floods from the different watersheds that affect the site of Assiut Refinery as well as the identification of risk zone areas of Assiut Refinery due to these flash floods are a must for the design of flood damages protection for the Assiut Refinery.

The watersheds of Mankabad area are unguaged watersheds, i.e. the records of the past storm depths and the corresponing outflow discharges of these watersheds are not available. The estimation of hydrologic respone of these ungauged watersheds can be obtained, however, depending on the geomorphological characteristics of these watersheds along with the design storm depths. This can be done via the recent method of watershed Geomorphological Instantaneous Unit Hydrograph. This geomorphological method is a useful tool in the estimation of the watershed hydrological response in regions with sparse, or no data. Based on the hydrologic response of the different watersheds that affect the site of Assiut Refinery as well as the topography of the surrounding plain areas for Assiut

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Table 1. - Comparison Between Formulas

Q_s million m^3/year			
measured	Galvin	CERC	Kamphuis et al
0 80	1 80	0 55	0.86

From this table it is shown that the Galvin formula (8) overestimates (Qs), whileas the CERC formula (5) underestimates it. The formula of Kamphuis et al (11) gives a very good estimate of (Qs) at Damietta.

Conclusions

This paper discusses the longshore sediment transport models. The friction factor, the initiation of sediment motion, the longshore currents, and four longshore sediment transport formulas are investigated. The following conclusions are reached:

1 — More investigations are needed to describe more accurately the friction factor in oscillatory flows, and its effect on sediment transport.

2 — The initiation of sediment motion criterion according to shields for unidirectional flow, can be modified to express oscillatory flow.

3 — Longshore currents need to be studied further by aquiring more field data. The effect of beach slope on these currents should be considered.

4 — The Galvin formula is used when the waves are the predominant cause of transport. It is not to be used if tide-induced currents or other processes contribute significantly to longshore transport.

5 — The CERC formula (5) predicts longshore sediment transport with the only dependence on wave characteristics.

However, dependence should be also on sediment characteristics, and beach conditions.

6 — The formula proposed by Kamphuis, Davlis Narin, and Sayao (11) takes in consideration the beach slope which is an improvement to the CERC formula.

7 — The procedure suggested by Bijker (4) calculates the total sediment as the summation of its two parts: the bed load, and the suspended load. It requires, however, detailed knowledge or assumed values of physical parameters such as bed forms, combined wave and current shear stress, reduction of wave height in the breaking process and lateral mixing.

8 — The formula of Kamphuis et al. (11) gives a better estimate of the longshore sediment transport at Damietta than the formulas of Galvin (8) and CERC (5).

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$$q_{bed} = 5\ D_{50} \frac{V}{C} g^{1/2} \exp \left[\frac{-0.27\ D_{50}\ \rho_g}{\mu \tau_c \left[1 + \frac{1}{2} (\varepsilon \frac{u_o}{v})^2 \right]} \right] \quad (22)$$

where, D_{50} is the representative particle diameter, v is the mean current velocity, C is Chezy coefficient, g is the acceleration of gravity, and Δ is the relative apparent density of the bed material defined as,

$$\Delta = (\rho_s - \rho) / \rho \quad (23)$$

where ρ_s is the mass density of bed material, ρ is the mass density of water, and μ is the ripple factor defined as,

$$\mu = (C / C_{90})^{1.5} \quad (24)$$

where C_{90} is Chezy coefficient based on the D_{90} particle diameter, and ε is Bijkers parameter defined as,

$$\varepsilon = C\ (f_w / 2g)^{1/2} \quad (25)$$

where f_w is Jonsson's wave friction factor (9), τ_c is the bottom shear stress due to current, and u_o is the maximum orbital velocity at the bed.

This bed load is assumed to take place in a layer with thickness equal to the bed roughness. The suspended load was then formulated by Bijker based on Einstein's concept as,

$$q_{sus} = 1.83\ q_{bed} \left[I_1 \ln (33\ d / k_s) + I_2 \right] \quad (26)$$

where q_{sus} is the suspended load, d is the local water depth, k_s is the bed roughness, and I_1, I_2 are Einstein's integrals given as,

$$I_1 = \frac{0.216\ (k_s/d)^{(z_*-1)}}{(1 - k_s/d)^{z_*}} \int_{(k_s/d)}^{1} \left(\frac{1-y}{y} \right)^{z_*} dy \quad (27)$$

$$I_2 = \frac{0.216 (k_s/d)^{(z_*-1)}}{(1 - k_s/d)^{z_*}} \int_{(k_s-d)}^{1} \left(\frac{1-y}{y} \right)^{z_*} \ln y\ dy \quad (28)$$

$$z_* = v_s / (k\ .\ u_{*c}) \quad (29)$$

where v_s is the sediment particle fall velocity, k is von Karman's coefficient, and u_{*c} is given as,

$$u_{*c} = u_* \left[1 + \frac{1}{2} (\varepsilon\ u_o / v)^2 \right]^{1/2} \quad (30)$$

in which u_* is the shear velocity due to current.

Ultimately, the total sediment load is,

$$Q_s = q_{bed} + q_{sus} \quad (31)$$

The Bijker approach require detailed knowledge or assumed values of physical parameters such as bed forms, combined wave and current shear stress, reduction of wave height in the breaking process and lateral mixing.

In order to make a comparison between the different formulas for calculating the longshore sediment transport, an example is solved. The site chosen is at Damietta on the Nile Delta Coast (2). The wave period is 9 sec, the breaker wave height is 1.05m, the breaking angle is 12°, the beach slope is 1:50, and the sediment mean grain size is 0.17mm. The measured longshore sediment transport (Q_s) is 0.8 million m^3/year.

Three formulas are used in the comparison: Galvin (8), CERC (5), and Kamyshuis et al. (11). These are expressed in Eq. (14), Eq. (17), and Eq. (20) respectively. The results are given in Table (1).

$$Q = 4500 \; H_b^2 \qquad (14)$$

where Q_s in m3/day, and H_b in meters.

The above equations give the longshore transport rate for the case that waves are the predominant cause of transport. These equations will not give an approximation if tide induced currents or other processes contribute significantly to longshore transport.

The wave energy flux approach attempts to relate the longshore sediment rate (Q_s) to the wave energy flux (P_{Ls}) The U.S. Army Corps of Engineers developed the well known CERC formula (5), Fig. (4).

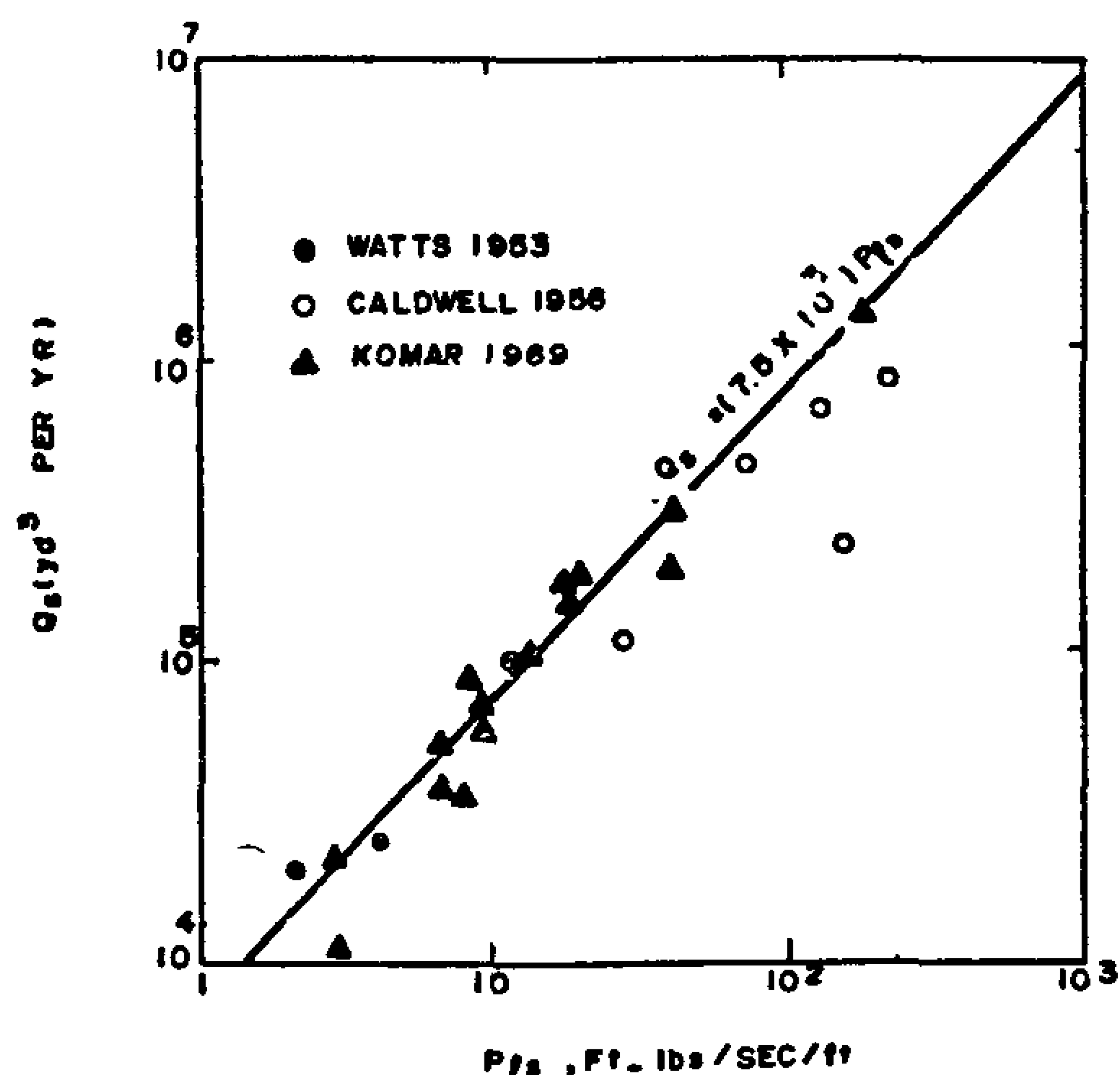


Fig. 4 Longshore Sediment Transport Rates (5).

$$Q_s = 7500 \qquad P_{ls} \quad (15)$$

where Q_s is the volumetric rate of longshore transport in cubic yards/year, and P'_{Ls} is the wave energy flux factor in ft-1b/sec/ft of beach, calculated using significant wave height in the surf zone,

$$P_{ls} = \frac{\delta}{16} H_b^2 \quad C_{gb} \quad \sin \alpha_b \cos \alpha_b \qquad (16)$$

where (H_b, C_{gb} α_b) are the breaking values of wave height, group celerity, and wave angle with shoreline respectively. In metric units, Eq. (15) becomes,

$$Q_s = 0.401 \qquad P_{ls} \quad (17)$$

where Q_s in m3/day and P_{ls} in ton. m/day/m.
If P_{ls} is calculated in ton.m/Sec/m, Eq. (17) becomes,

$$Q_s = 34640 \qquad P_{ls} \quad (18)$$

In spite of its widespread application, the CERC formula accurately predicts the longshore sediment transport rate only over a narrow range of conditions. The assumption of a constant wave power coefficient prevents any differentiation between the bed load and the suspended load transports, nor does it allow any accounting of the sediment grain size or the beach slope.

Kamphuis, Davies, Narin, and Sayao (11) proposed an energy, related sediment transport expression in S.I. units,

$$Q_s = 2\ 56 \; \frac{m}{D} H_b^{7/2} \; \sin \alpha_b \cos \alpha_b \qquad (19)$$

where Q_s in kg/Sec, m is beach slope, D is sediment grain size in meters, H_b is the wave breaker height, and α_b is the angle the breaking waves make with the shoreline.

In metric units, Eq. (19) becomes,

$$Q_s = 83.37 \; \frac{m}{D} H_b^{7/2} \; \sin \alpha_b \cos \alpha_b \qquad (20)$$

where, Qs in m3/day.

The beach slope (m) is given by Kamphuis and Sayao (10) as,

$$m = 1.8 \left(\frac{H_b}{D} \right)^{-0.5} \qquad (21$$

Starting from the Kalinske-Frijlink formula (7) which predicts the transport near the bottom, Bijker suggested a formula for the bed load in the coastal environment as (4),

$$V_l = \frac{5\pi}{8} \cdot \frac{m}{c} u_m \ \mathrm{Sin}\ \alpha_b \qquad (7)$$

where m is the beach slope, c is a frictional drag coefficient, α_b is the angle breaking waves make with the shoreline, and u_m is the maximum value of the horizontal orbital velocity at breaking and is given by,

$$u_m = \left(\frac{2 E_b}{\rho d_b} \right)^{1/2} \qquad (8)$$

in which ρ is the fluid density, d_b is the water depth at breaking, and E_b is the energy density of breaking given by,

$$E_b = \left(\frac{\rho g H_b^2}{8} \right) \qquad (9)$$

The sediment transport studies of Komar and Inman (13) suggested that,

$$v_l = 2.7\ u_m \ \mathrm{Sin}\ \alpha_b \qquad (10)$$

Komar (12) showed that this equation should be modified to,

$$v_l = 2.7\ u_m \ \mathrm{Sin}\ \alpha_b \ \mathrm{Cos}\ \alpha_b \qquad (11)$$

This last equation was solved with Eq. (8) using a value of $(H_b/d_b) = 0.75$ to give,

$$v_l = 1.17\ (g\ H_b)^{1/2}\ \mathrm{Sin}\ \alpha_b \ \mathrm{Cos}\ \alpha_b \qquad (12)$$

A comparison of Eq. (12) with field and laboratory measurements is shown in Fig. (3).

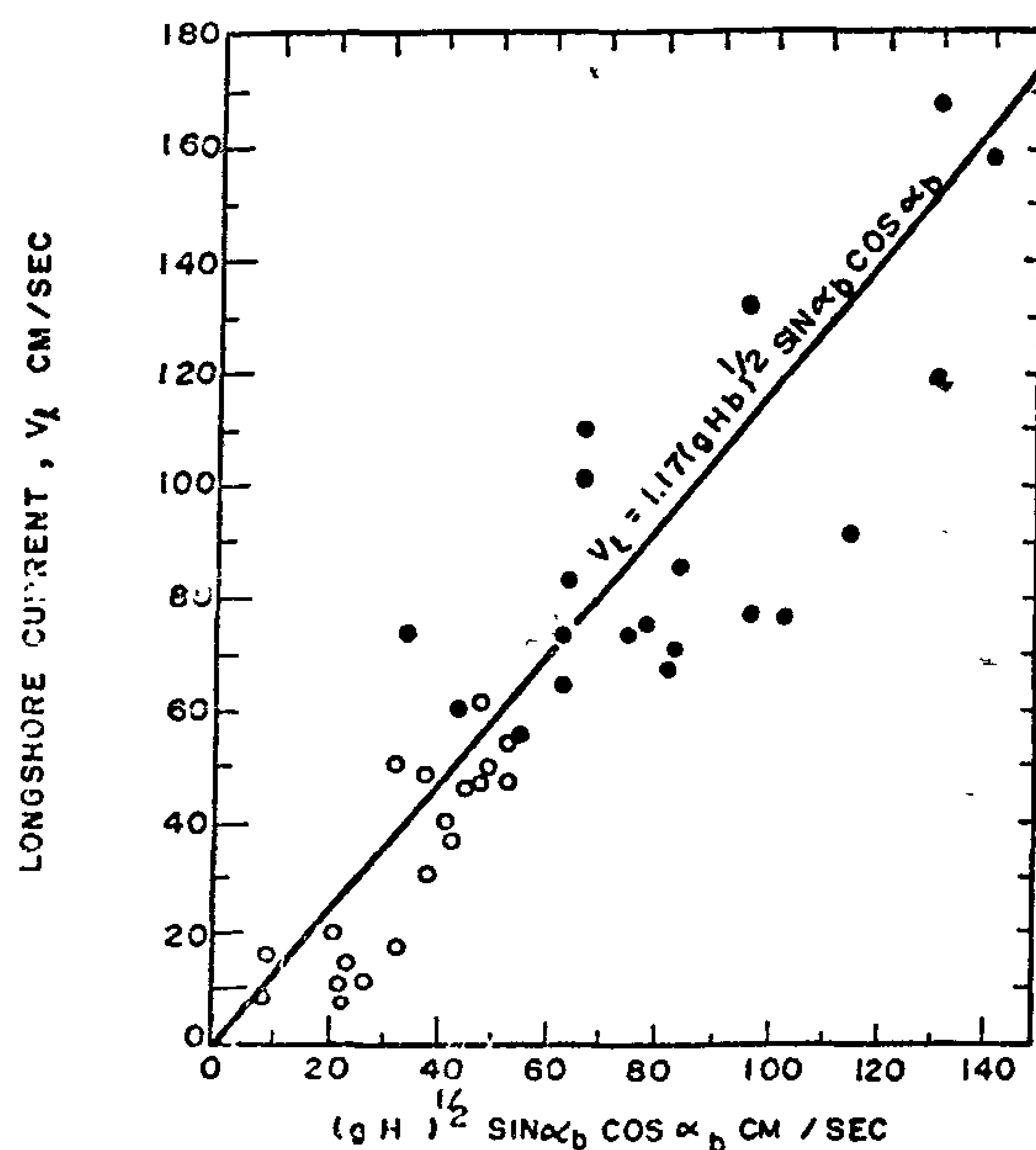


Fig. 3 Longshore Currents (12)

Longshore Sediment Transport Formulas

Waves breaking at an angle to a shoreline cause sediment to be moved latterally along the beach (1). The turbulence created by wave breaking and longshore currents, are largely responsible for this motion. The sediment transport occurs in two modes; bed load, and suspended load.

Many longshore sediment transport formulas have been proposed for coastal engineering practice. The use of such formulas, however, is still limited due to the lack of field measurements for their verification. In this paper; four methods for predicting the rate of longshore transport will be discussed. These are of Galvin (8), CERC (5), Kamphius et al., (11) and Bijker (4).

Galvin (8) related the longshore rate (Q_s) with the mean annual breaker height based on field data of longshore sediment transport rate,

$$Q_s = 2 \times 10^5\ H_b^2 \qquad (13)$$

where Q_s in yards³/year, and H_b is the breaker wave height in feet.

In metric units, Eq. (13) becomes,

number defined as,

$$R_n = (u_o \cdot a) / \nu \qquad (4)$$

in which ν is the fluid kinematic viscosity. According to Jonson, the flow remains laminar in the boundary layer only as long as (Rn) is less than about 12600. By this criterion, all prototype investigations will be turbulent. He gave a graph for the wave friction factor(f_w) as a function of (R_n) and the relative roughness parameter (a/k_s), Fig. (1).

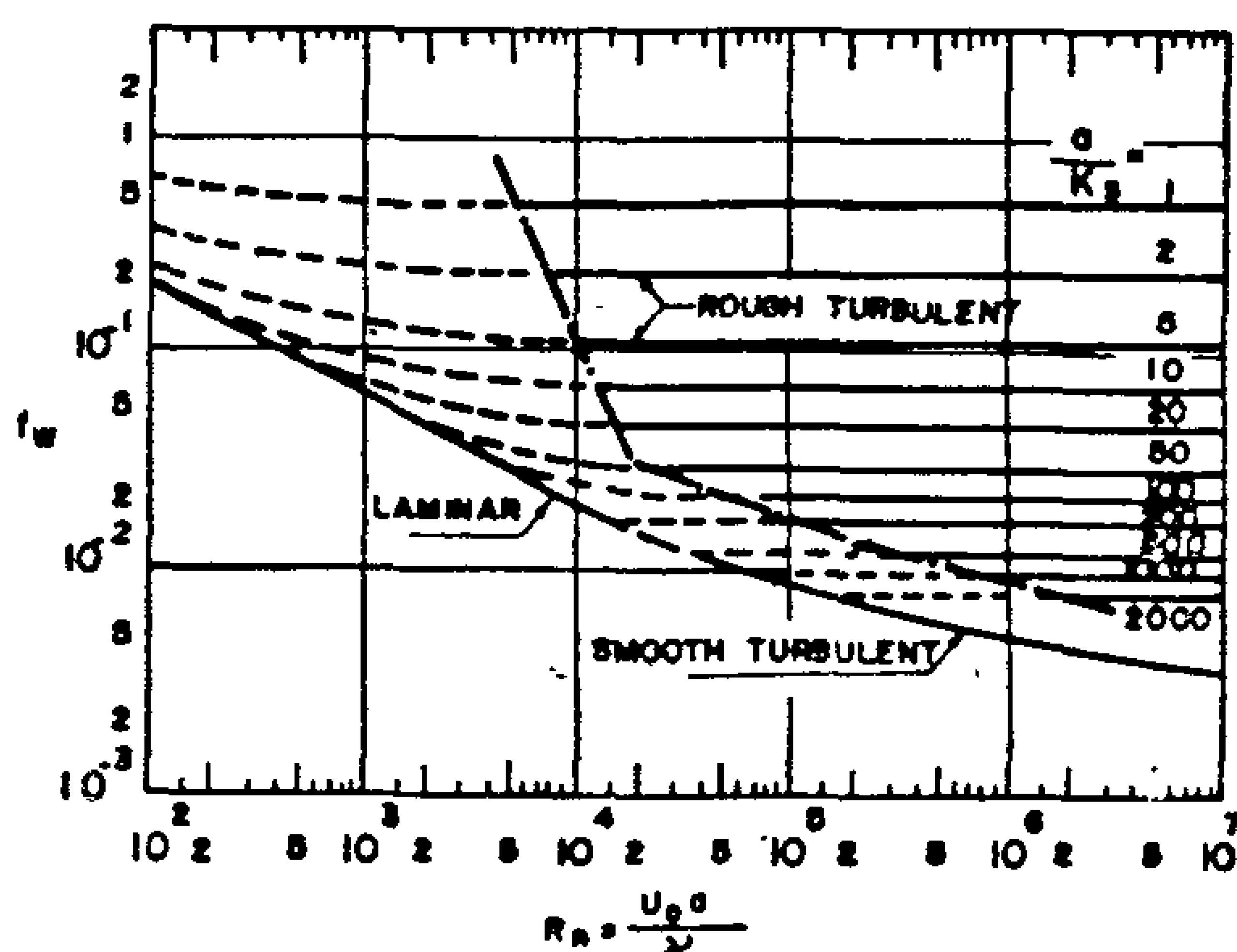


Fig. 1 Wave Friction Factor (9)

The variable (k_s) is the Nikuradse sand roughness coefficient. This graph shows that, for rough turbulent flow, (f_w) becomes dependent on (a/k_s) only.

Initiation of Sediment Motion

A widely accepted criterion for the initiation of sediment motion on a plane bed is given by Shields (17). Shields entrainment function is,

$$\theta = \frac{\tau_o}{(\rho_s - \rho) g D} = f\left(\frac{u_* \cdot D}{\nu}\right) \qquad (5)$$

where τ_o is the bed shear stress, ρ is the fluid density, ρ_s is the sediment density, g is the acceleration of gravity, D is the grain size, $u_* = \tau_o/\rho$ is the shear velocity, and ν is the fluid kinematic viscosity The value of τ_o corresponding to zero transport was defined as the critical shear stress τ_c.

Dingler (6), Komar and Miller (14), and Madesen and Grant (16) have concluded that oscillatory flow data on motion initiation agree with the shields criterion within experimental scatter.

Willis (18) plotted the computed initiation of sediment motion in Fig. (2) using Ackers and White method (3) as Shields parameter (Θ), against dimensionless grain size (D_{gr}) given by,

$$D_{gr} = D \left[\frac{g(S_s - 1)}{\nu^2} \right]^{1/3} \qquad (6)$$

The shields parameter (Θ) is simply the square of the Ackers and White mobility number. Willis found that most of the oscillatory flow points lie above the two curves for unidirectional flow.

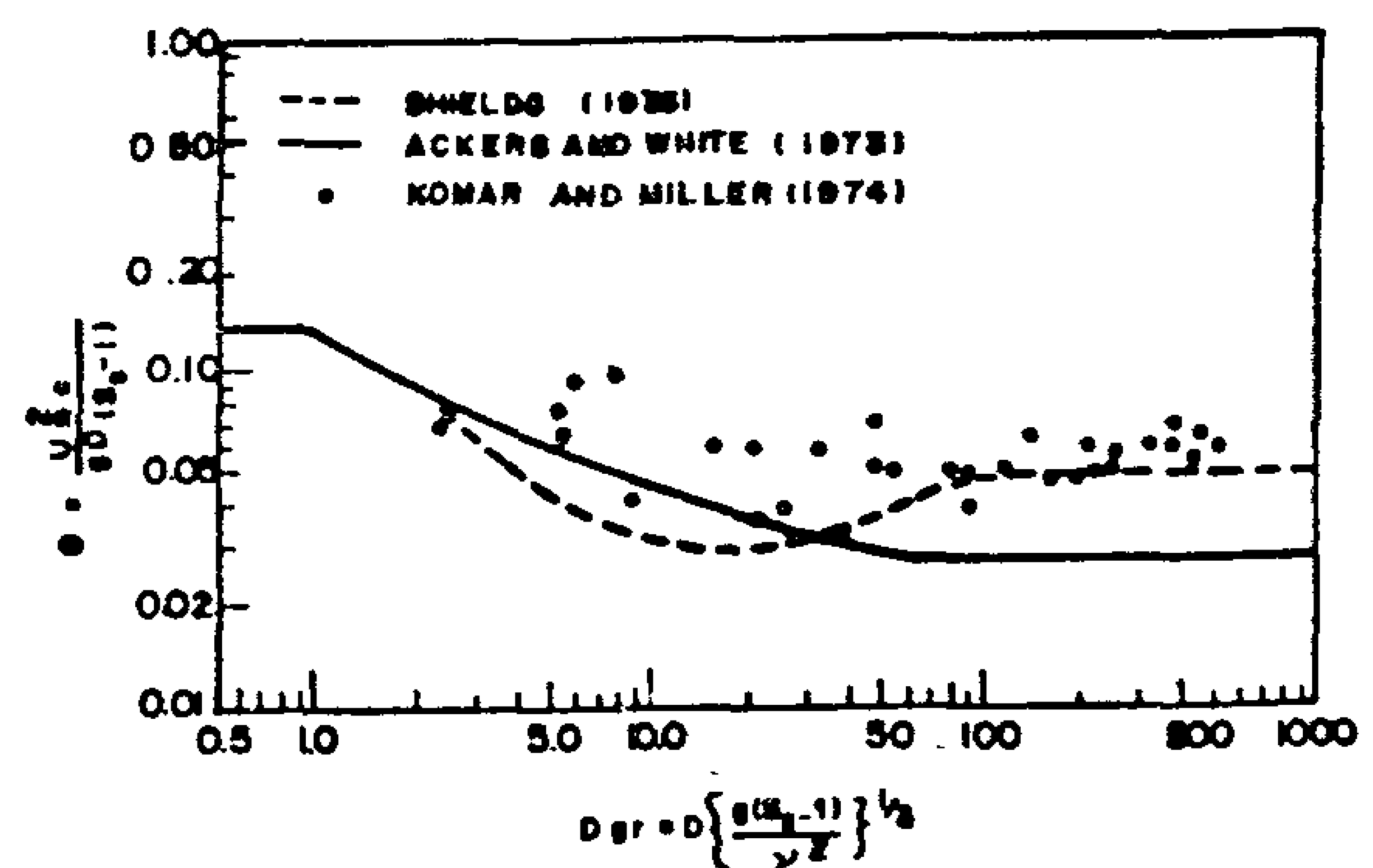


Fig. 2 Initiation of Sediment Motion (18)

Longshore Currents

When waves approach a straight coastline at an oblique angle, a mean longshore current is generated parallel to the coastline. Longshore currents are very important in transporting the sediment set in motion by the breaking waves.

Longuet - Higgins (15) attributed the longshore current velocity to the longshore component of the radiation stress which is the momentum flux associated with the wave propagation. He derived for the mean longshore velocity (v_L) in the breaker zone the simple relationship,

LONGSHORE SEDIMENT TRANSPORT MODELS

by

Farouk M. Abdel-Aal*

Abstract

The design of many coastal engineering projects depends on reliable estimates of longshore sediment transport in both magnitude and direction. Coastal engineers are often required to predict the rate of erosion and deposition associated with coastal structures, thus there is a need for an accurate and easily applied longshore transport model.

This paper investigates the longshore sediment transport models. The friction factor, the oscillatory boundary layer, the longshore current, and the initiation of sediment motion by waves are also discussed.

Introduction

Analysis of longshore transport rate may be approached in two ways: the wave energy flux approach, and the shear stress modification approach. The first approach attempts to relate longshore sediment rate to wave energy flux. The U.S. Army Corps of Engineers developed the well known CERC formula (5). In spite of its widespread application, the CERC formula accurately predicts the longshore sediment transport rate only over a narrow range of conditions.

The second approach attempts to formulate a sediment entrainment function based on shear stress alone. It assumes that all entrainment mechanisms are related to the shear stress generated by the combination of waves and currents. The approach is examplified by the work of Bijker (4). He computed the total longshore sediment transport as the summation of the bed load and the suspended load.

In this paper different formulas are used to calculate the longshore sediment transport at Damietta on the Nile Delta Coast.

The Friction Factor

In steady flow it is known that the shear stress at the bed is directly proportional to the square of the average velocity for turbulent flow. This analogy has been extended to oscillatory flow by Jonsson (9). He related the maximum bed shear stress (τ_o) and the maximum horizontal water particle velocity (u_o) through a coefficient (f_w), termed the wave friction factor as;

$$\tau_o = \frac{1}{2} \; f_\omega \; \rho \, u_o^2 \qquad (1)$$

in which ρ is the fluid density and,

$$u_o = (2 \pi / T) \; a \qquad (2)$$

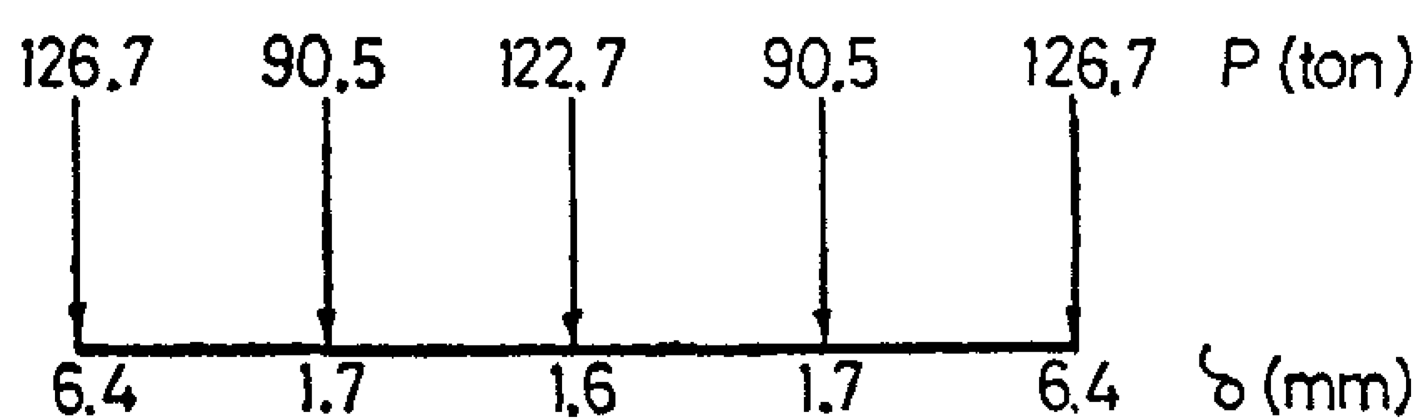
where T is the wave period, and a is the wave orbital amplitude just outside the boundary layer. For a laminar boundary layer. the wave friction factor can be reduced to,

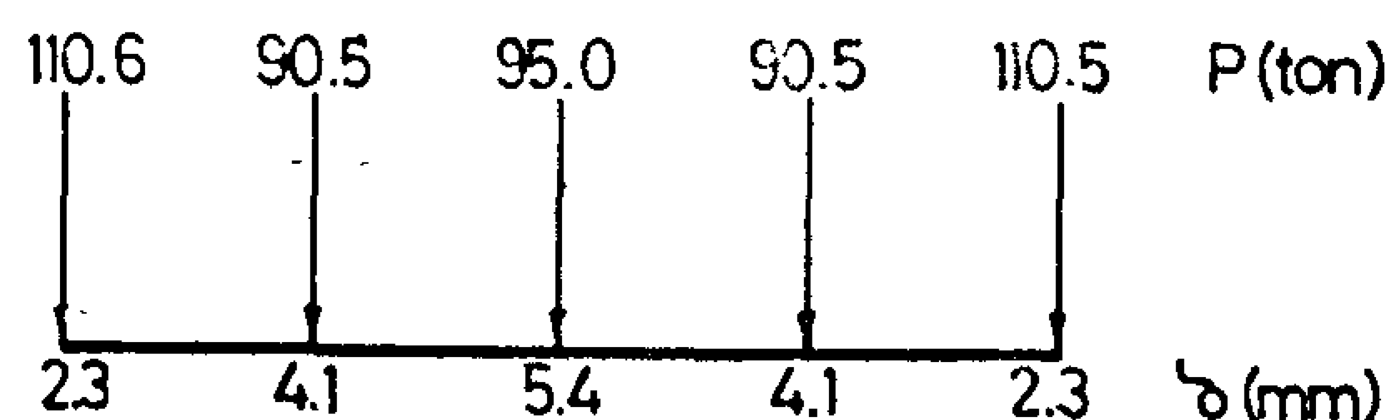
$$f_\omega = 2 / (R_n)^{1/2} \qquad (3)$$

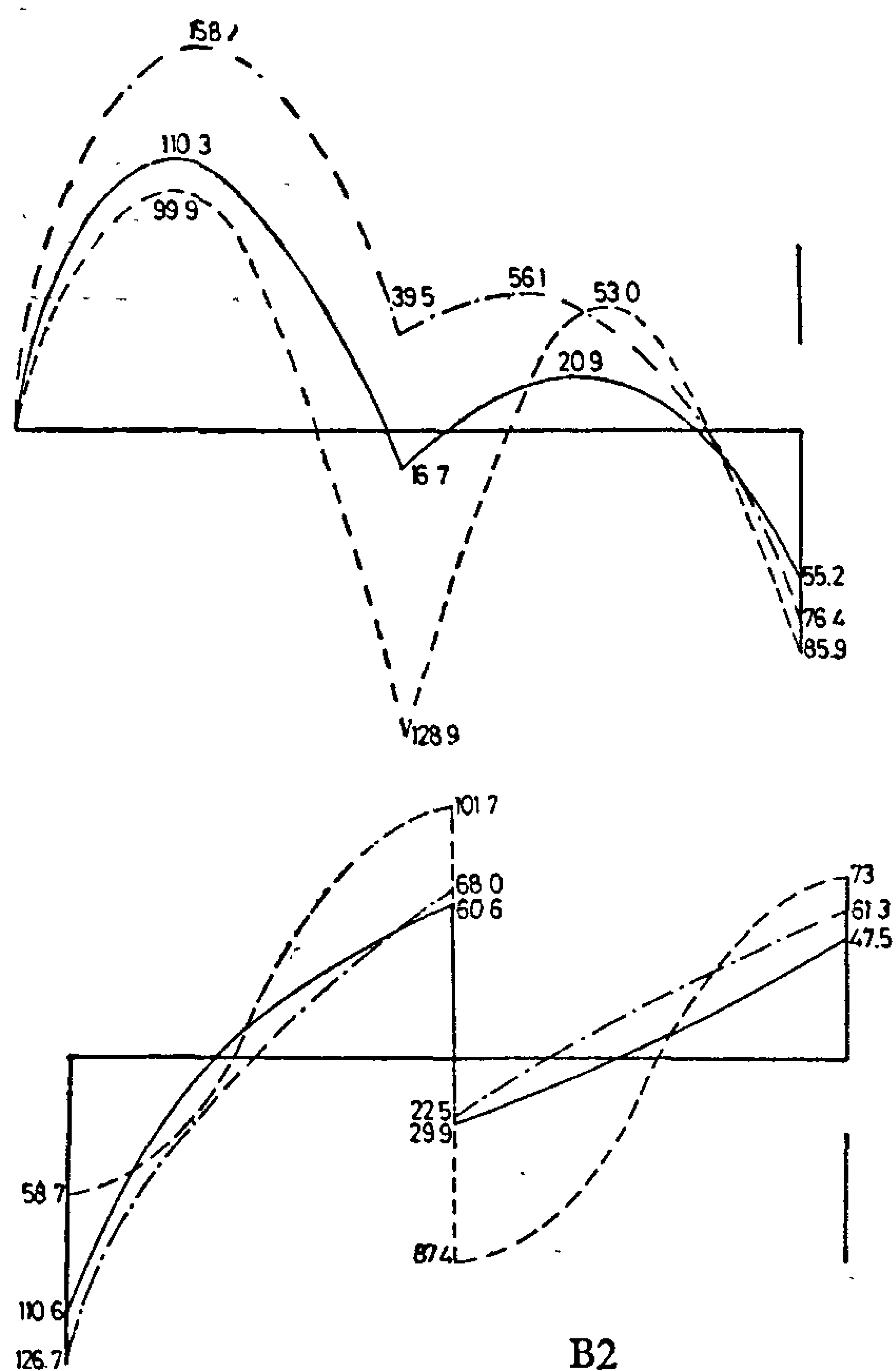
where Rn is the wave amplitude Reynolds

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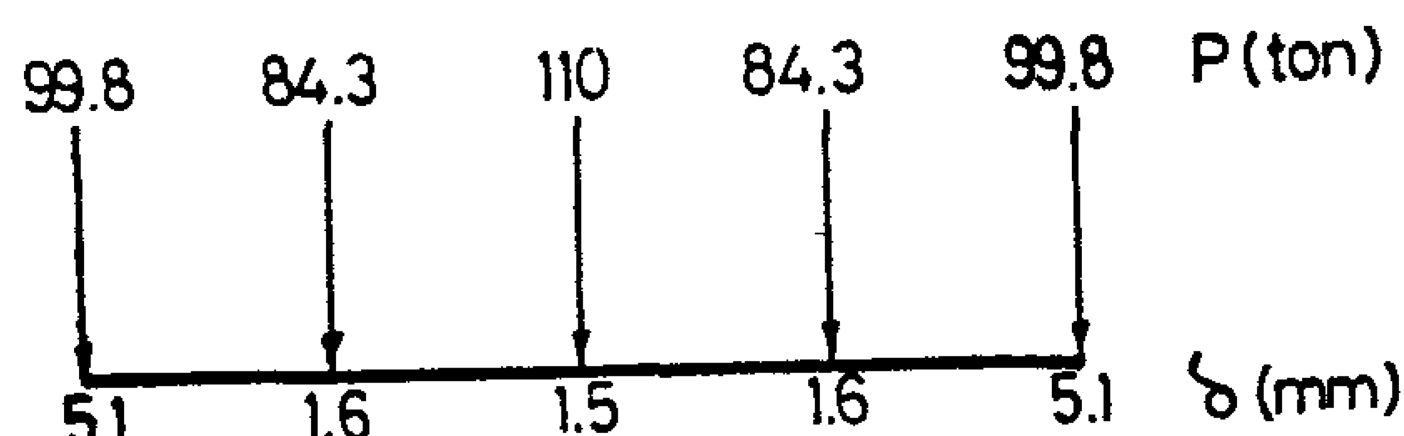
* Professor of Coastal Engineering, Cairo University, Giza, Egypt.

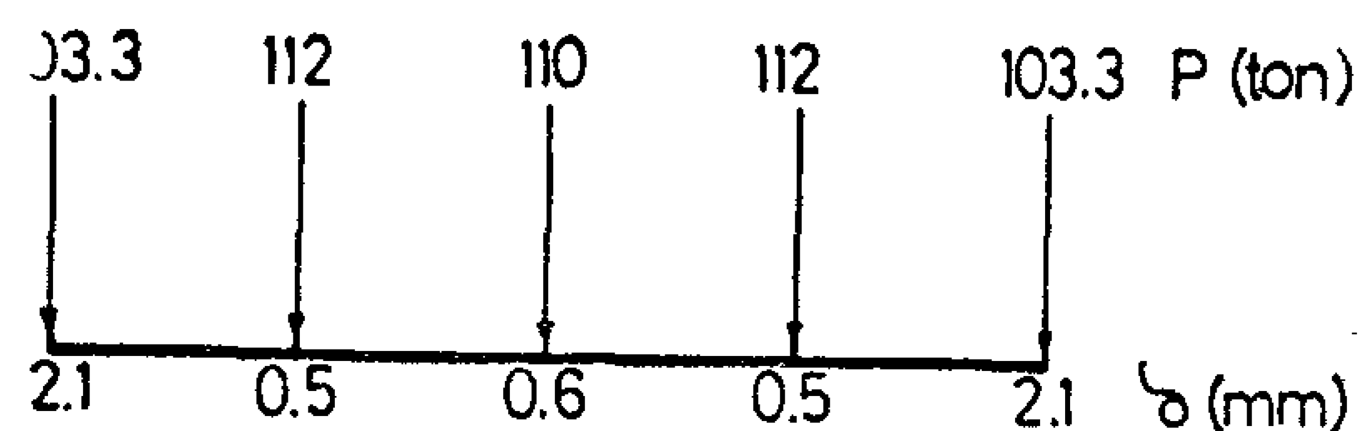


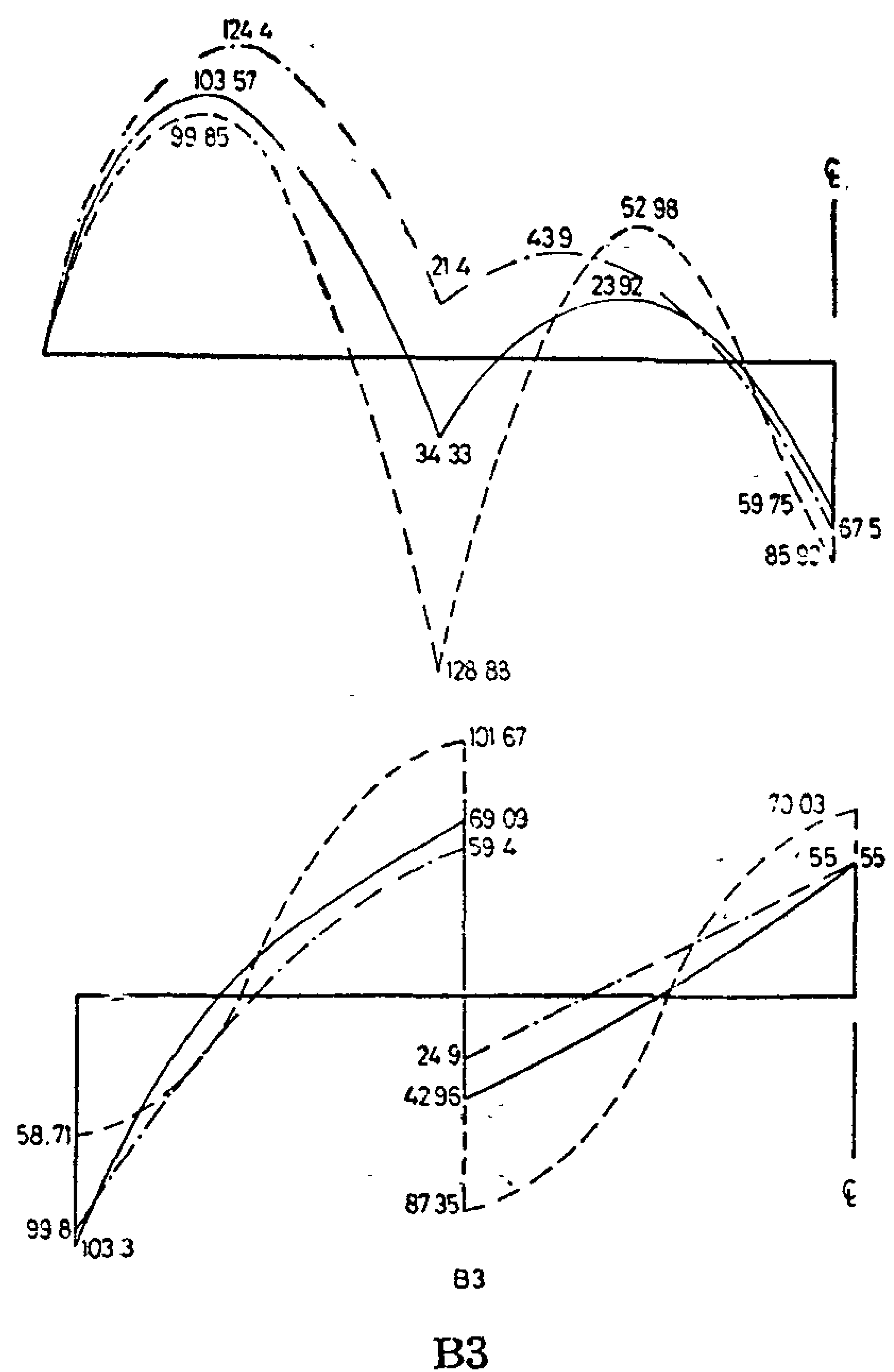




B2







B3

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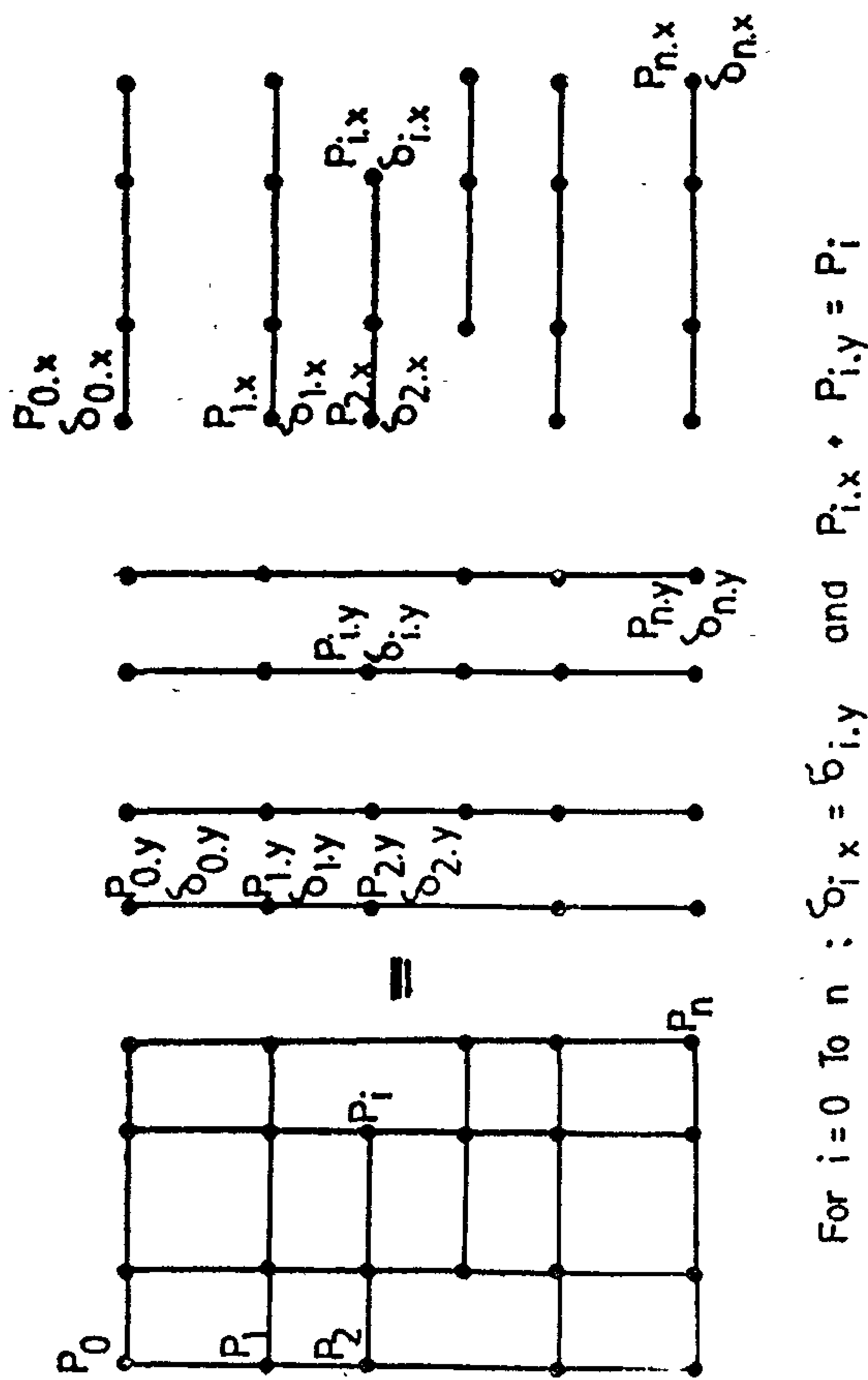
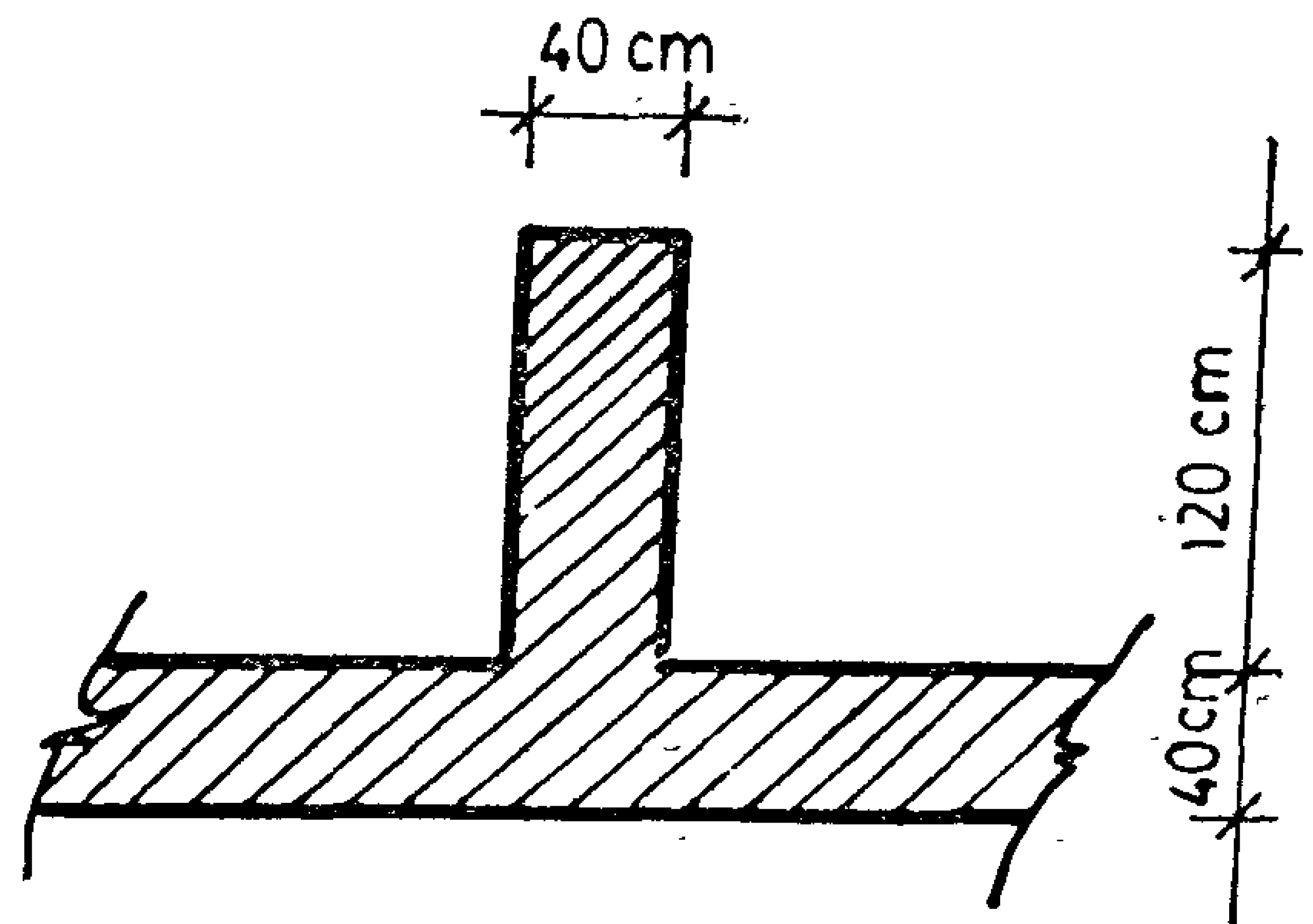
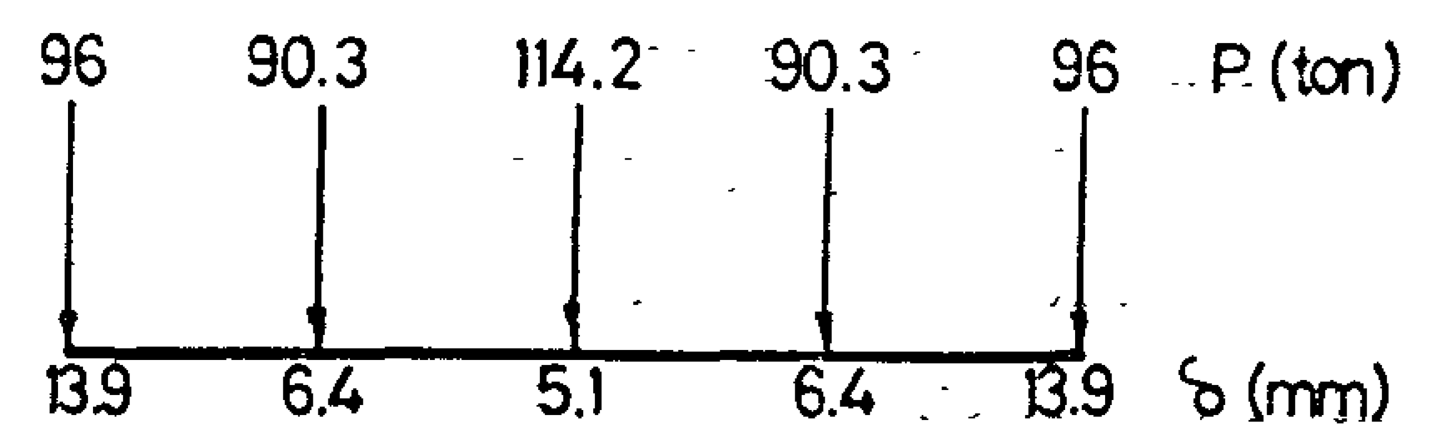


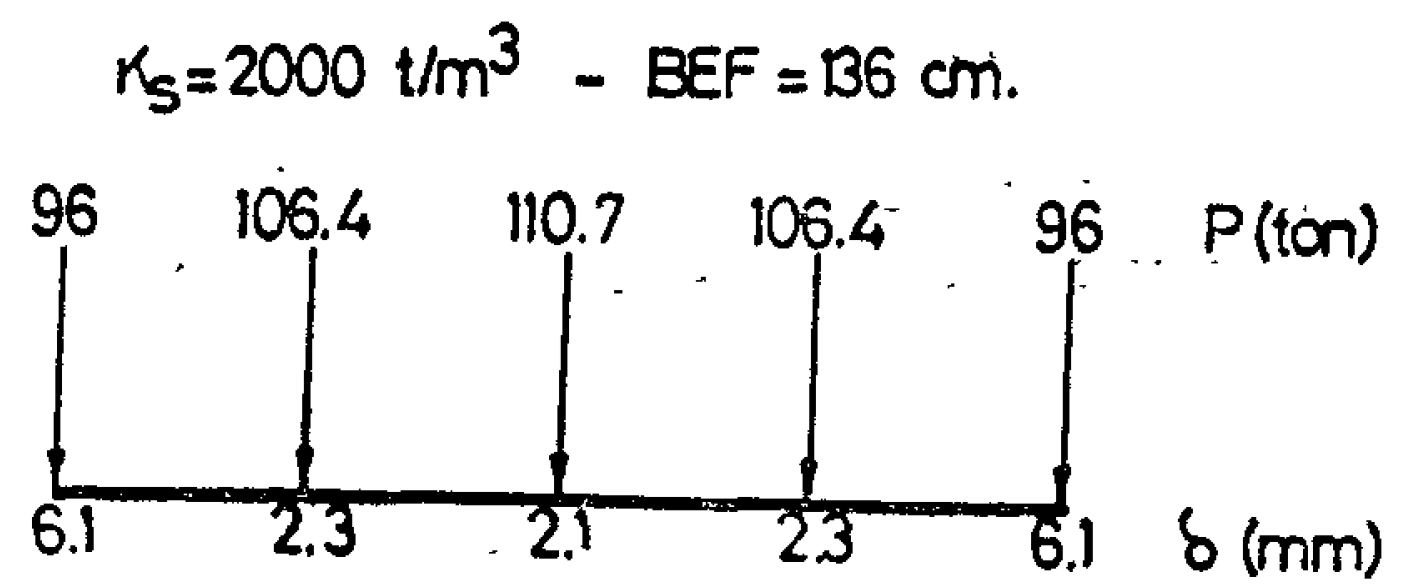
Fig. (2)



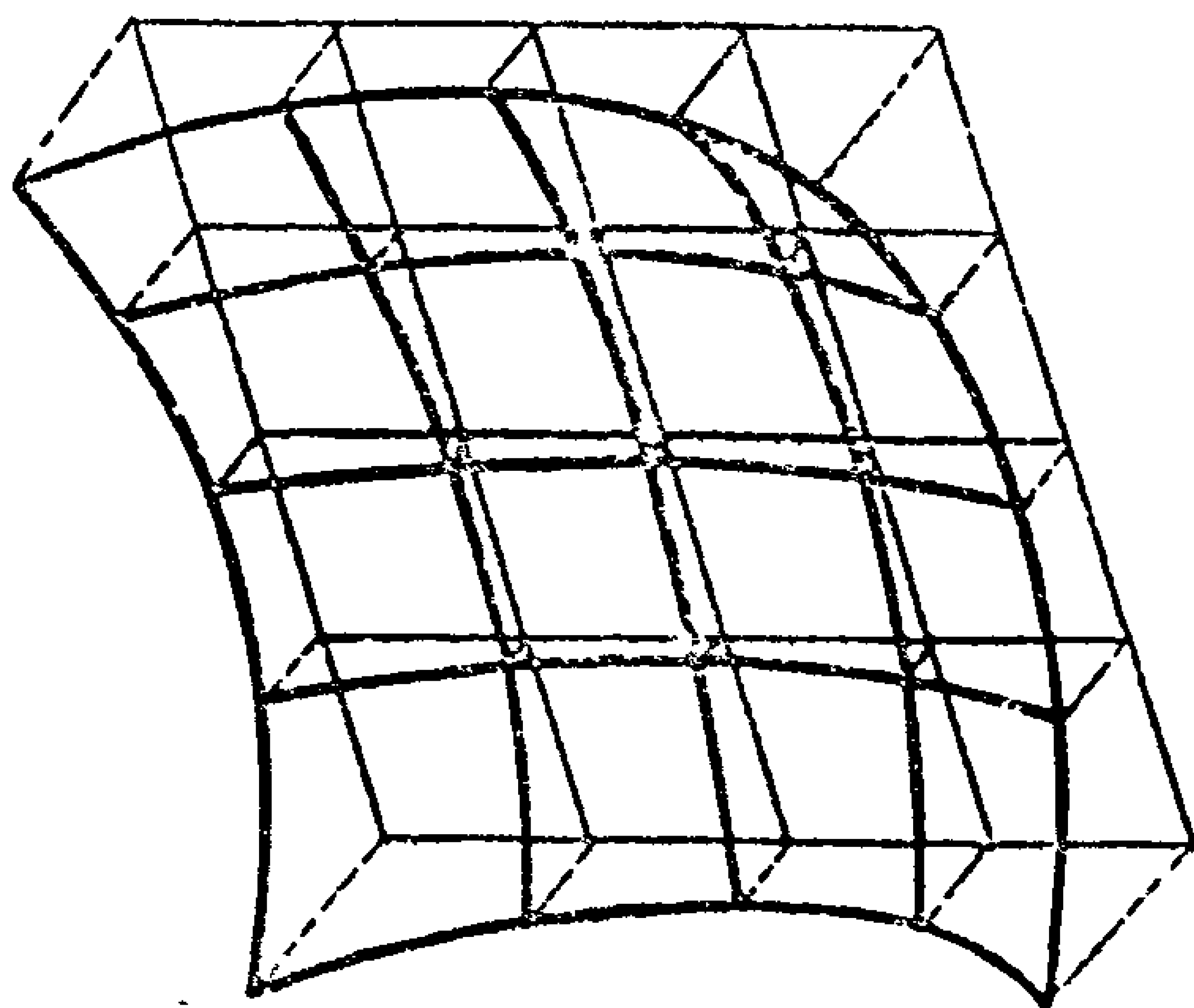
Typical secⁿ in Raft Beams.



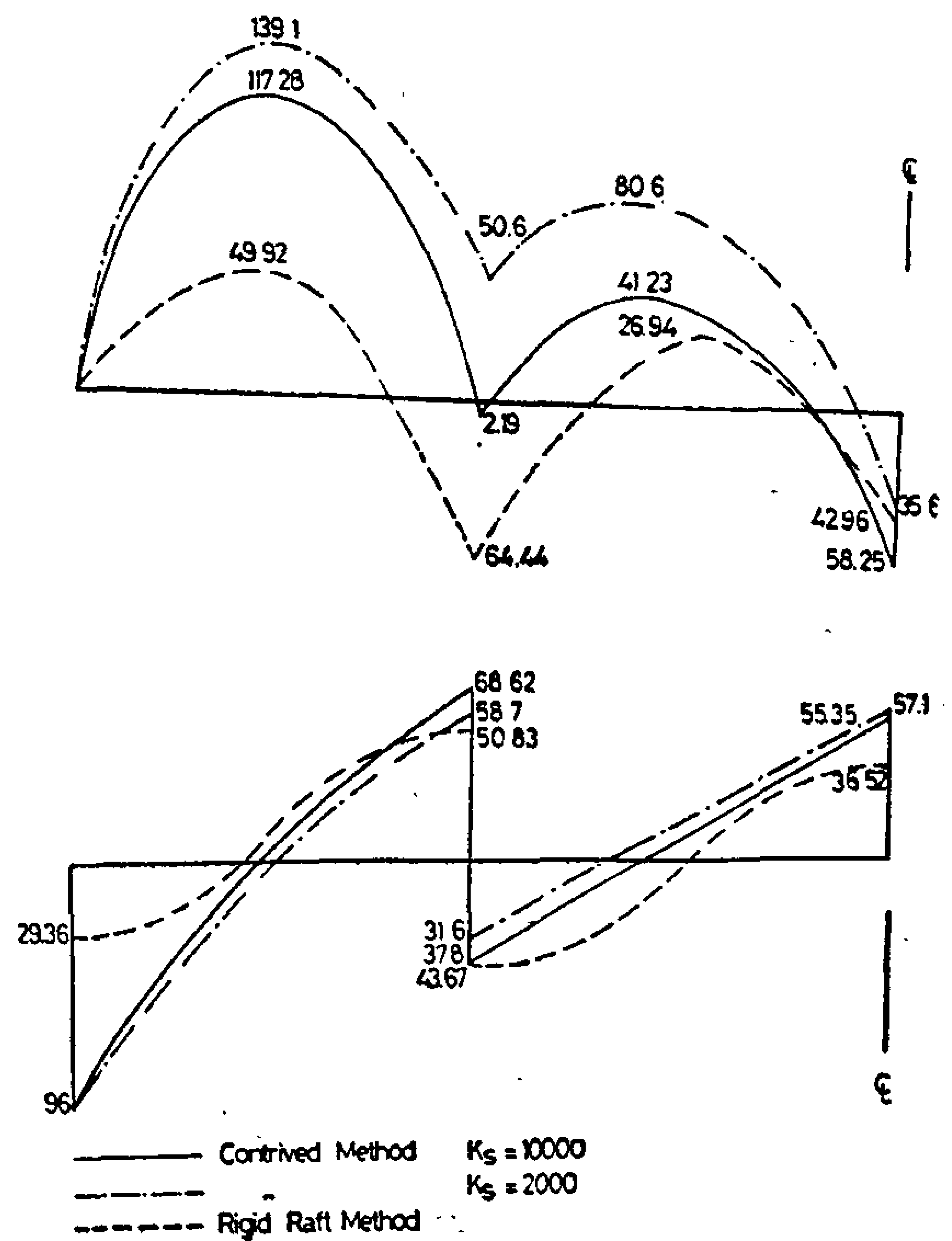
$K_s = 2000$ t/m³ - BEF = 136 cm.



$K_s = 10000$ t/m³ - BEF = 75 cm.



Configuration of Deformed Raft.



B1

So the values P_i/y_i depend also upon actual values of soil reactions on beams (P_j).

Actually, beams of rafts of that type are not so close and hence the values of a_{ij} ($i \neq j$) tend to diminish very rapidly so, the value a_{ii} will be the dominant factor in estimating the value of (P/y) for different beams.

A reasonable start is to assume that the raft will settle uniformly and to determine (P/y) accordingly by formulating the matrix [A] for the set of beams connected with one slab. The value of (P/y) for beam i is the summation of all elements S_{ij} in row i of the inverse matrix $[S] = [A]^{-1}$

These tentative values of (P/y) are used to solve the raft. The values of P obtained from the solution (average values) can be used to refine the values of (P/y) using equation (6) and those are to be used again. Two cycles or three at most are enough to reach acceptable convergence.

CONCLUSION

The simplicity and reliability of the contrived method makes the analysis of beam type raft an easy task. Once the computer has been fed by data of raft geometry and loads, complete analysis for all beams are obtained within few hours. The results can be studied and raft dimensions refined to get better design. Few iterations can give the engineer the best possible design. There will be no need for extra reinforcement or concrete that are wasted usually in case of uncertainty. One advantage of this method is that the characteristic global matrix of the raft is in terms of nodal vertical settlements only (effect of nodal rotations in the X, Y directions is merged in through the formulation of submatrices of individual beams). Thus we have the opportunity to analyse bigger rafts in shorter time.

Thus the method assists a lot in obtaining an economical and reliable design.

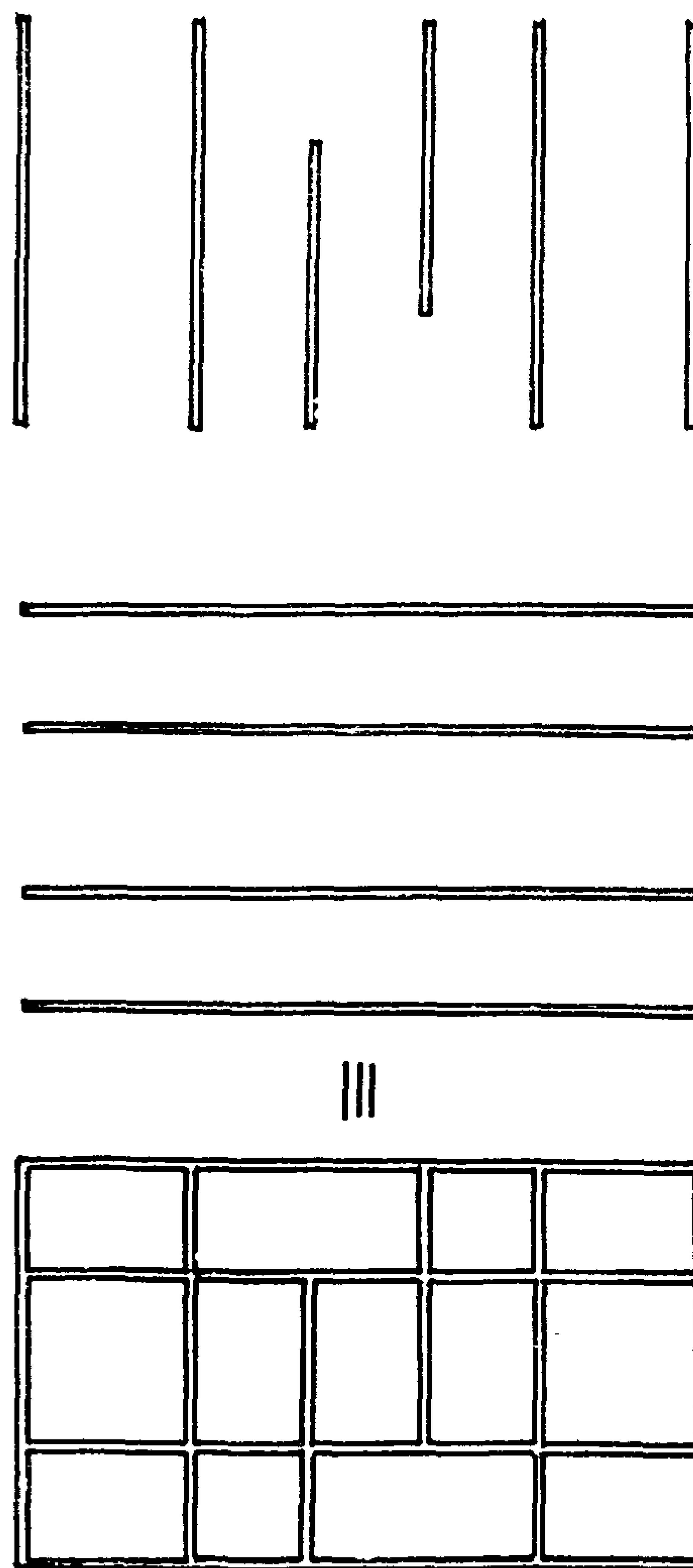


Fig. (1)

tion force relation but for the raft as a whole which can be written as:

$$[R] . \vec{D} = \vec{F} \qquad (5)$$

-- The element r_{ij} is the force required at point j to maintain the raft with a deformed configuration with unit displacement at raft node i while all other displacements are zero without any rotation constraints. According to matrix rules the elements r_{ij} can be calculated by summing up values of S_{ij} for all beams according to their location in the raft.

-- $\vec{D}$ is the vector of nodal vertical settlements of the raft.

-- $\vec{F}$ is the vector of external loads applied at nodal points of the raft.

Solving eq. (5) we can get the values of nodal settlements D.

To analyse any beam we can substitute in eq (4) by the values of D to get nodal loads for that beam producing nodal defiections equal to those already obtained for the raft.

Using the rule of superposition and Hetenyi eqs, M,Q,Y at any point in the beam can be calculated.

ESTIMATION OF BEAM BREADTH B:

In Hetenyi eqs. we use the parameter

$$\lambda = \sqrt[4]{K_S . B/4 . EI}$$

Where:

Ks = Soil subgrade reaction.

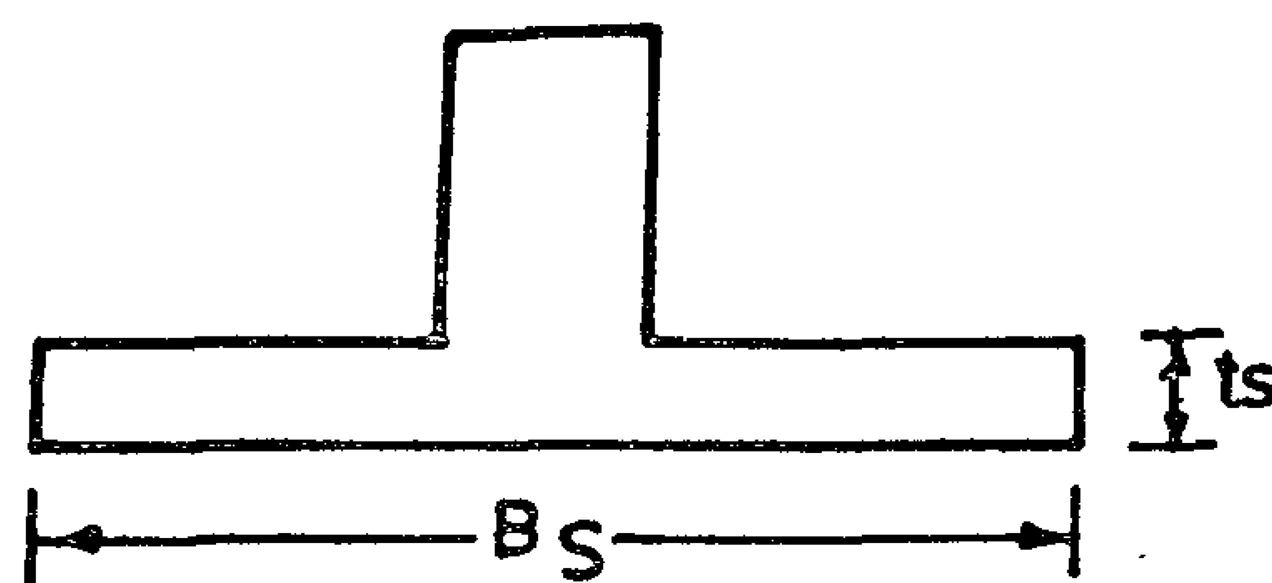
B = Breadth of beam (in contact with soil).

I = Moment of inertia of beam.

In the case of a T Section the value of B cannot be taken as the breadth of beam web since the flange is also participating in transfering between soil and beams. Also total breadth of flange cannot be considered since the flange will tend to bend and hence the beam will not deflect uniformly along the width of the flange.

To overcome this problem we have to reconsider the value Ks.B which can be looked upon as the force (P) necessary to produce unit deflection (y = 1) to a unit length of the beam and so:

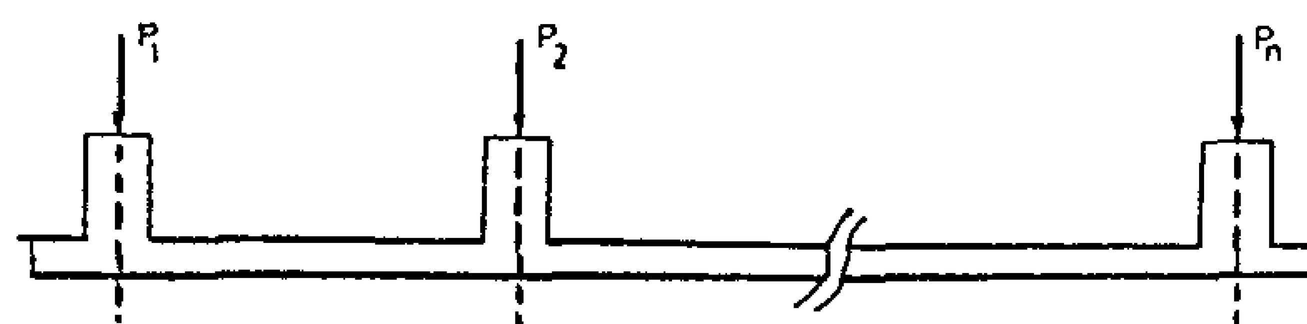
$$K_S . B = P/y \qquad \text{and } \lambda = \sqrt[4]{(P/y)/4EI}$$



For a beam with a discrete flange as that shown in fig, the value (P/y) can be determined directly by applying unit load (P=1) to Hetenyi eq. (2. a) using the values L = BS, I = $ts^3/12$ to get the deflection y1 at load point.

Hence $P/y = 1/y_1$ to be used to determine the value of λ.

In the general case where the flange is a concrete slab participating in transferring loads between soil and all beams in one direction, the factor P/y for a particular beam can be inferred as follows:



The relation between loads and deflections for a set of beams connected by one slab can be written as follows:

$$a_{i1} . P_1 + a_{i2} . P_2 + \cdots + a_{ii} . P_i + \cdots + a_{in} . P_n = y_i$$

dividing by y_i :

$$a_{i1} . P_1/y_i + a_{i2} . P_2/y_i + \cdots + a_{ii} . P_i/y_i + \cdots = 1$$

From which

$$\frac{P_i}{y_i} = \frac{1}{a_{ii} + \sum_{\substack{i=1 \text{ to } n \\ i \neq j}} a_{ij} . (P_j/P_i)} \qquad (6)$$

$$Q = \frac{P}{\sinh^2 \lambda L - \sin^2 \lambda L} \{(\cosh \lambda x \sin \lambda x + \sinh \lambda x \cos \lambda x) X (\sinh \lambda L \cos \lambda a \cosh \lambda b - \sin \lambda L \cosh \lambda a \cos \lambda a) + \sinh \lambda x \sin \lambda x [\sinh \lambda L (\sin \lambda a \cosh \lambda b - \cos \lambda a \sinh \lambda b) + \sin \lambda L (\sinh \lambda a \cos \lambda b - \cosh \lambda a \sin \lambda b)]\} \quad (2c)$$

Where K_s = Soil subgrade reaction.

The matter of to how extent the soil can be considered to have elastic behavior is not included in this paper. Generally, a computer should be used to perform the analysis since it necessitates voluminous amount of calculations that can not be performed manually.

The main idea of the method is to consider the raft as a set of beams resting on elastic foundation and that these beams are working individually, fig. (1). They are under the action of nodal loads (unknown), fig. (2), and the action of subgrade soil pressure and the relation between nodal loads and soil pressure is according to Hetenyi. Two conditions should be satisfied to make the model identical to the actual raft:

(i) The summation of beams nodal loads for different beams at any particular node should be equal to the load transferred to the raft at that node (Stability Condition).

(ii) Nodal loads for any particular beam should produce vertical nodal displacements identical to those of other beams intersecting with that beam at these nodes due to nodal loads for these beams. (Compatibility Condition).

The method of determining nodal loads for different beams is outlined as follows:

By the inspection of Hetenyi equations, it is clear that Y, M, Q vary linearly with P. Hence the rule of superposition can be applied to get values of Y,M,Q for more than one load. In the beam shown, the relation between nodal deflections and nodal loads can be written as:



$$a_{11}.P_1 + a_{12}.P_2 + \dots + a_{1j}.P_j + \dots + a_{1n}.P_n = y_1$$
$$\dots$$
$$a_{i1}.P_1 + a_{i2}.P_2 + \dots + a_{ij}.P_j + \dots + a_{in}.P_n = y_i$$
$$\dots$$
$$a_{n1}.P_1 + a_{n2}.P_2 + \dots + a_{nj}.P_j + \dots + a_{nn}.P_n = y_n$$

In matrix notation this can be written in the form:

$$[A].\vec{P} = \vec{y} \quad (3)$$

The element a_{ij} of the matrix [A] is defined as the deflection at node j due to unit load at node i. These values can be calculated using Hetenyi equation (a) where:

L = Total length of beam.

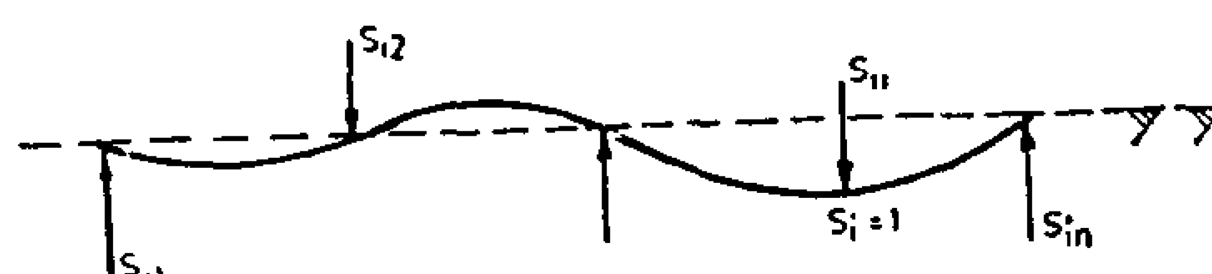
a = Ordinate of node i measured from origin (left side edge of beam).

x = Ordinate of node j measured from origin.

Premultiplying equation (3) by the matrix (S) where (S) is the inverse matrix of (A) we get :

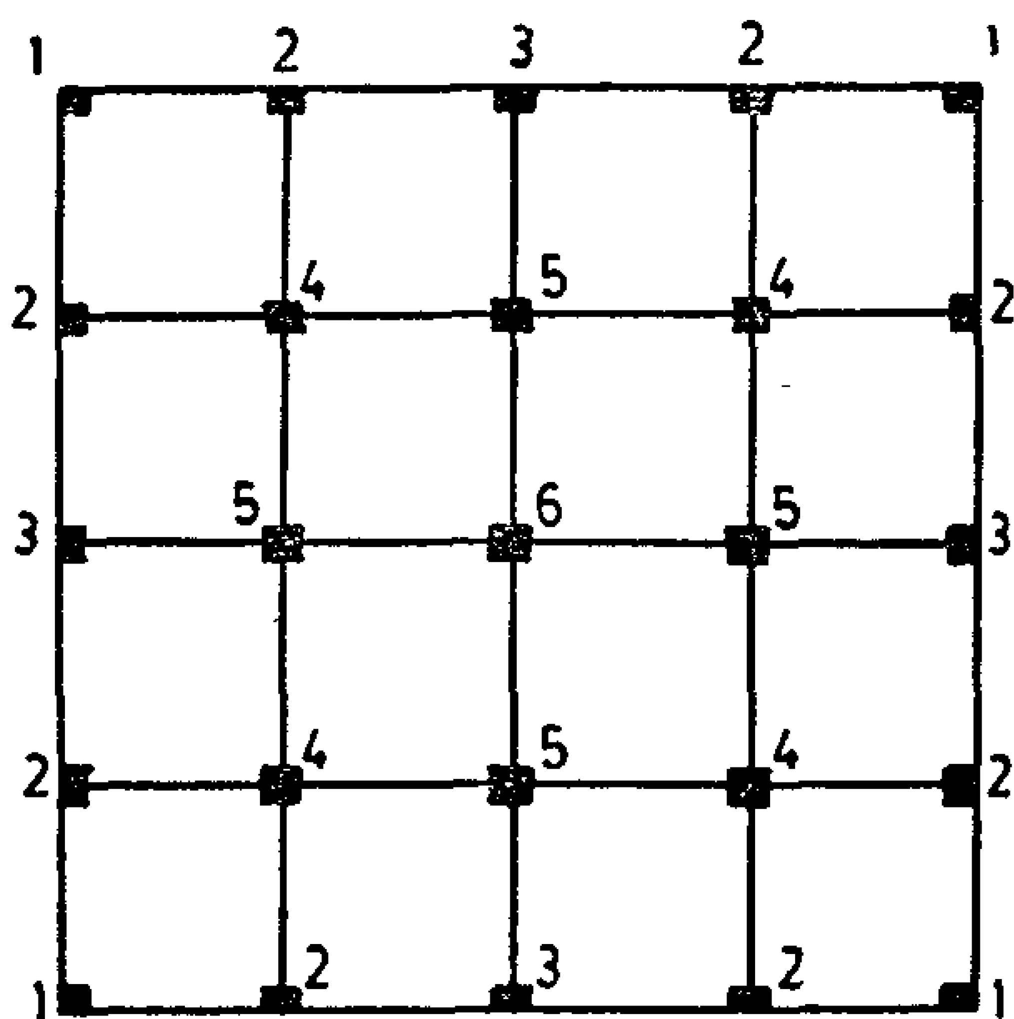
$$[S].\vec{y} = \vec{P} \quad (4)$$

The element S_{ij} of the matrix [S] is defined as the force required at node j to maintain the beam having a deformed configuration with unit displacement at node i and zero displacement at all other nodes without any rotation constraints at any node. (To satisfy conditions of Hetenyi eqs).

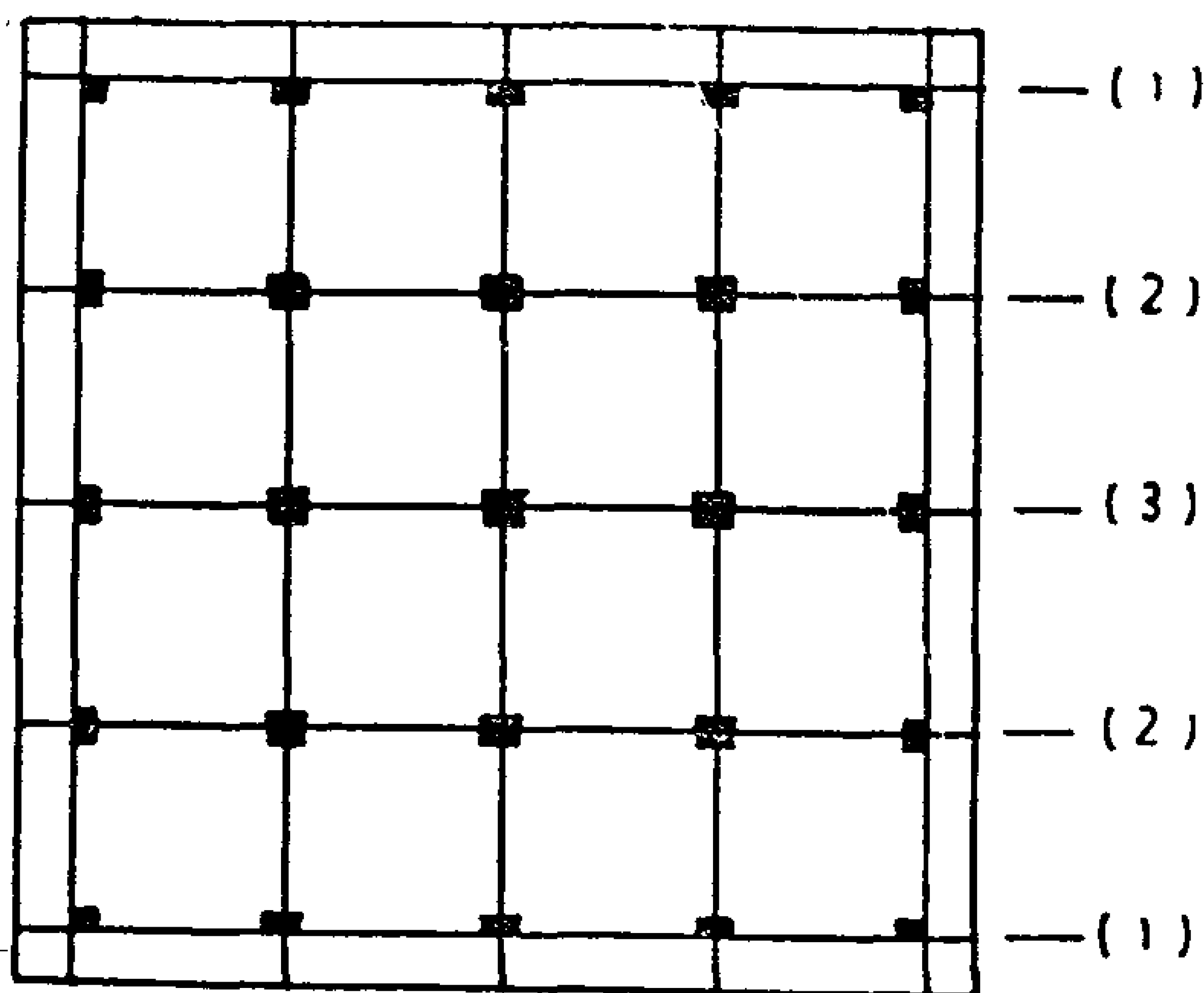


The elements S_{ij} of the matrix [S] can be accumulated for all beams to formulate the matrix [R] representing the deflec-

5 storey warehouse building with structural system as shown below. The ceilings are loaded with a uniform load 1t/m2 and a peripheral load 1.5 t/m. Weight of intermidate beams is .5 t/m. The raft system is similar to that of the ceiling but without cantilevers. The analysis of ceiling and raft gives results as shown in appendix while deviation in reactions is illustrated in the table below.



4 × 6.00 m.
Raft System



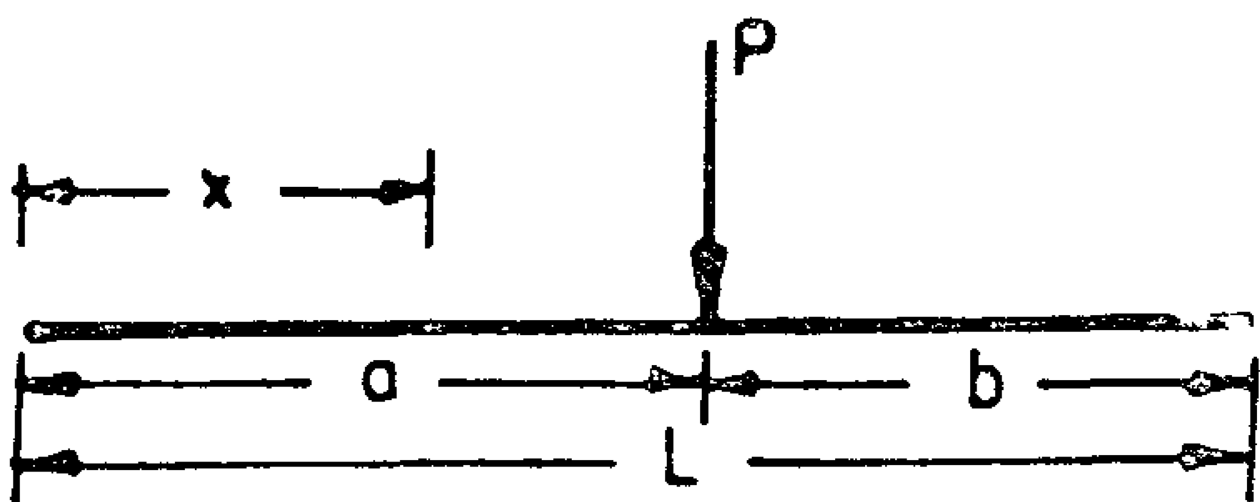
4 × 6.00 + 2 × 1.50 m.
Ceiling System

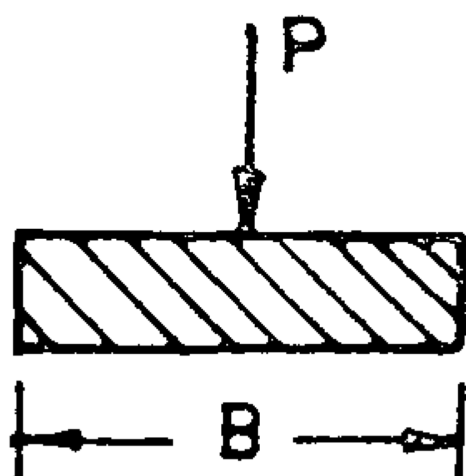
Column Pattern	Column Load (Tons)	Reaction From Soil (Tons)
1	192	59
2	217	153
3	214	132
4	181	378
5	207	335
6	220	292

The results obtained - regardless to the degree of vertuality of the sample example give an idea about the extent of deviation that can take place and whether the method of «Rigid Raft» can be considered as a reliable method or not.

SUBJECT

In this paper, another way of analysis that overcomes the problem of these discrepancies is introduced. The mehod is based on the Winkler assumption for beams with finite length on elastic foundation and Hetenyi equations - for deflection y, bending moment M and shear Q at a point distances x from left side point - given below (Bowles, 77):





$$\lambda = \sqrt[4]{K_s \,.\, B/4EI}$$

$$y = \frac{P\lambda}{k_s(\sinh^2\lambda L - \sin^2\lambda L)}\{2\cosh\lambda x \cos\lambda x (\sinh\lambda L \cos\lambda a \cosh\lambda b - \sin\lambda L \cosh\lambda a \cos\lambda b) + (\cosh\lambda x \sin\lambda x + \sinh\lambda x \cos\lambda x)[\sinh\lambda L (\sin\lambda a \cosh\lambda b - \cos\lambda a \sinh\lambda b) + \sin\lambda L (\sinh\lambda a \cos\lambda b - \cosh\lambda a \sin\lambda b)]\} \quad (2a)$$

$$M = \frac{P}{2\lambda(\sinh^2\lambda L - \sin^2\lambda L)}\{2\sinh\lambda x \sin\lambda x (\sinh\lambda L \cos\lambda a \cosh\lambda b - \sin\lambda L \cosh\lambda a \cos\lambda b) + (\cosh\lambda x \sin\lambda x - \sinh\lambda x \cos\lambda x) \times [\sinh\lambda L (\sin\lambda a \cosh\lambda b - \cos\lambda a \sinh\lambda b) + \sin\lambda L (\sinh\lambda a \cos\lambda b - \cosh\lambda a \sin\lambda b)]\} \quad (2b)$$

ANALYSIS OF BEAM TYPE RAFT FOUNDATION AS GRIDS ON WINKLER MODEL

Mohamed Mohamed El Shamy*

ABSTRACT

In this paper an easy and reliable method for the analysis of beam type raft is introduced. The method is built on the Winkler model for beams on elastic foundation. Complete equilibrium and compatibility are attained when using this method.

The theoretical procedure is explained in detail. An example is solved by one of the conventional methods and contrived method. To illustrate the effect of soil nature on raft behavior, the solution is performed for two cases of soils with different characteristics. The difference is represented by the factor Ks known as the soil subgrade reaction which is taken 2000, 10000 ton /m3 respectively for the to cases.

Finally, a computer program - written in BASIC-is available (free). For a computer with 60 K.B., the program can perform the analysis for rafts with up to 85 nodes.

INTRODUCTION

One of the widely used methods in the analysis of raft foundations is the assumption of a «Rigid Raft». In that method the raft is supposed to be rigid enough to withstand any flexural deformation and only rigid body movements can take place. According to this condition, the contact pressure is of planar distribution and its centroid coincides with the line of action of the resultant of all loads acting on the raft.

The soil contact pressure (q) at any point a (x, y) can be calculated using the formula:

$$q = \frac{N}{A} \pm \frac{N \cdot e_y}{I_x} \cdot y \pm \frac{N \cdot e_x}{I_y} \cdot x \quad (1)$$

Where

N = Total load on the raft.

A = Total area of the raft.

x,y = Coordinates of any point on the raft with respect to the principal axes X and Y passing through the centroid of the raft area.

e_x, e_y = Coordinates of the resultant force.

I_x, I_y = Moment of inertia of the raft area with respect to the X and Y axes respectivly.

Once the soil contact pressure has been determined, design of the raft can proceed using ordinary statics rules. In the case of «Inverted Beams» type raft, the soil pressure is dealt with in a manner similar to that employed in the analysis of two-way slab. Proceeding in that way, reactions on columns can be calculated. As a condition for stability, it is supposed that these reactions should be equal to the loads at these points but usually they are not and there is always some deviation. The amount of this deviation varies according to loading conditions and to the degree of similarity or dissimilarity of the arrangement of beams layout in the raft with that in the superstructure. Sometimes, this deviation is of a minor value but in others, it is of a value that can not be tolerated with. The following example illustrates this discussion. It is a

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here in order to accomodate all non-linear behavioral modes of response of different structural components. With the introduction of new Egyptian code of practice, it seems inevitable that the requirments of achieving structural integrity; for this type of construction; be addressed in such a way that design engineers would be able to produce a structural system capale of surviving an abnormal event without going through a catastrophic failure process. The results of this analysis clearly points out to the fact that introducing provisions to avoid catastrophic failure will result a significant increase in the cost of the structural system. This in turn is a significant factor that should be taken in consideration while addressing this problem.

NOTATION

B.E. = Beam element

B.S.. = Bearing spring. This refers to grouting of vertical joints between wall panels.

D.b. = Diameter of the tie or strand.

F.E. = Finite element

F.e. = Friction element. It refers to horizontal wall to floor joint.

I.c. = Integral Column

M.c. = Mechanical connector for transfer of vertical shear.

P.u. = Ultimate tie capacity

P.E. = Panel element

R.S. = Rotational spring to simulate the beam-column connection.

S.E. = Slip element to model slip of transverse tie.

T.T. = Transverse tie.

V.T. = Vertical tie.

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Table 1.0 Design PARAMETERS

Component		Parameter	Value
1.	Walls	Compressive strength Thickness	350 kg/cm^2 15 cm
2.	Grout	Compressive Strength	350 kg/cm^2
3.	Horizontal Joint	Max. Comp. load	3000 kg/cm^2
4.	Transverse Tie	Area Yield Strength	1.82 cm2 18900 kg/cm^2
5.	Vertical Tie	Area Across Joint Area Across Panel Yield Strength	6.6 cm^2 5.1 cm^2 1400 kg/cm^2
6	Dry pack	Comprssive Strength	630 kg/cm^2
	Frame	Comprssive Strength	320 kg/cm^2

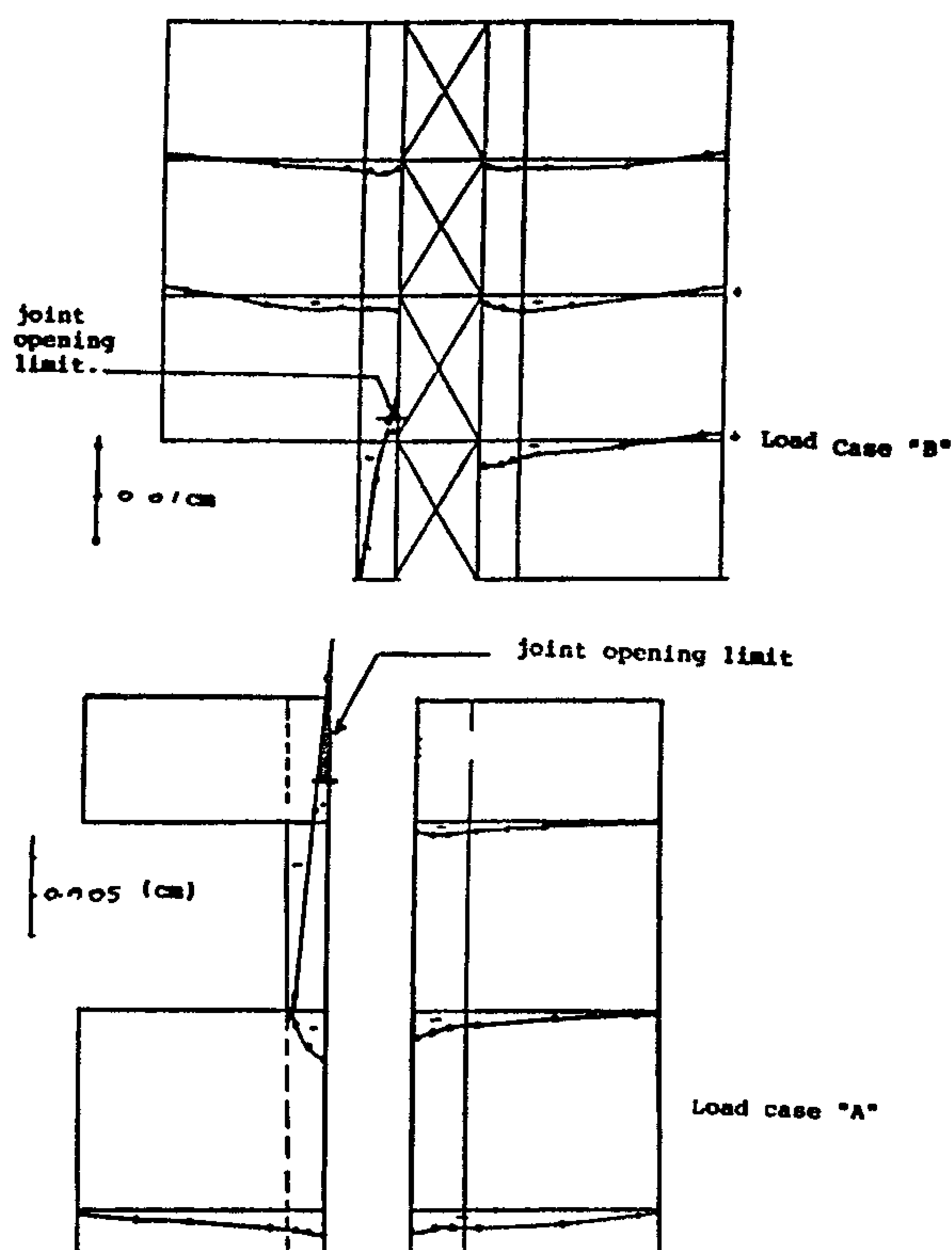


Fig. (6) Normal deformation across horizontal joints.

4. Comparing the two abnormal events it becomes evident that failure of the second top panel is the most critical mode of failure with regard to transmitting the loads safely to the ground. Secondly, it is evident that considering the vertical loads only and ignoring the effect of the eccentricity under estimates the forces acting on the joints.

5. Slip across the horizontal joint has occurred at the top joint of the integral column as a result of joint opening in case 'A'. In case 'B', the shear resistance exceeded the shear load and the joint remained intact.

6. The results of max. deflection and horizontal tie force are in agreement with the P.C.A. [4] conclusion that the most serious abnormal event is the one causing initial damage to the second top panel. This however, is not true withregard to the design of the horizontal joint and the vertical ties. For those two components, failure of the bottom panel seems to be the most critical design case.

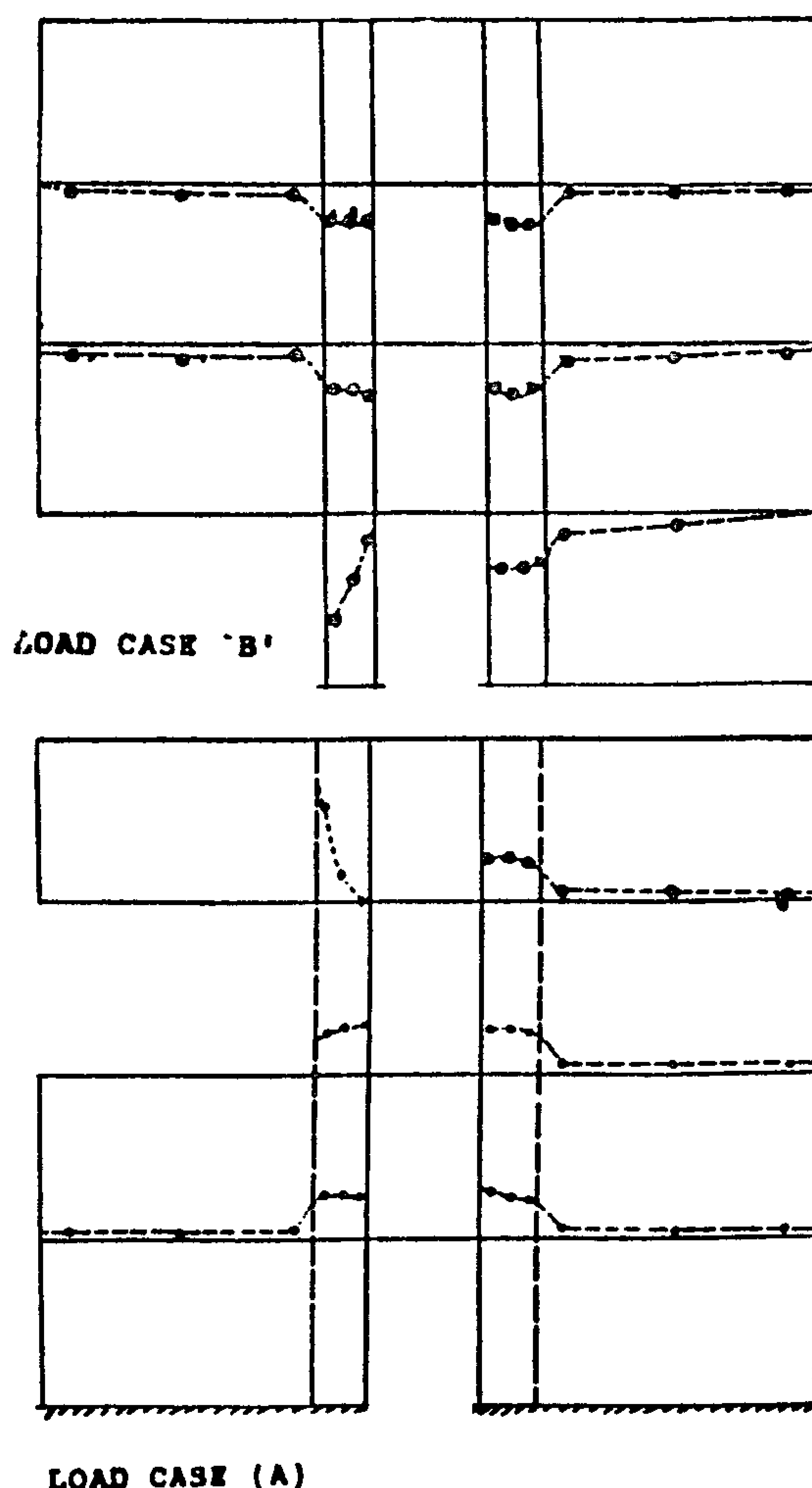


Fig. (7) Distribution of shear strength along the joint.

CONCLUSION

The results presented in this article have clearly demonstrated the significant and serious variations in response to loading stages of present large panel structures. Abnormal loading results severe Straining actions on different segments of the structure compared to those resulting from design to normal overload (i.e., ultimate load). In fact, in some cases a complete load reversal may occur.

It is believed that this type of construction should be designed using compli cated models such as the one presented

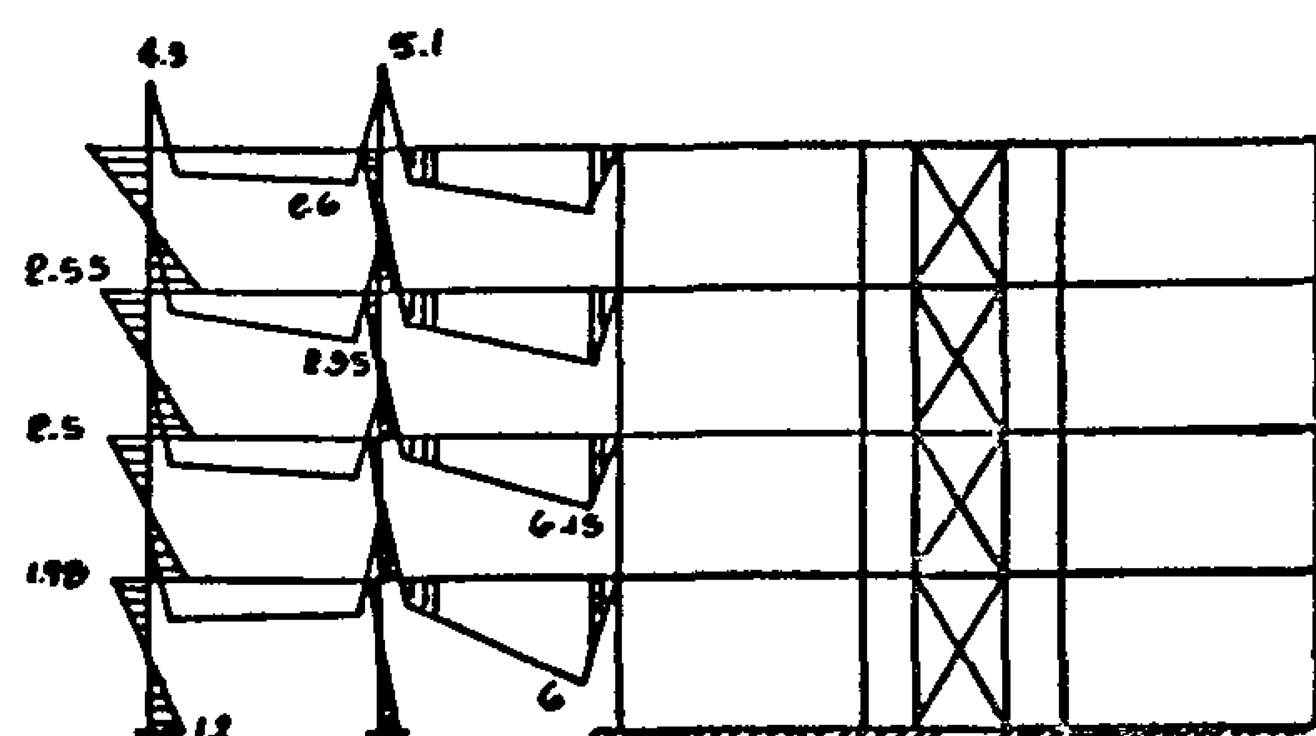


Fig. 3. A) W = 1.4 D.L. + 1.7 L.L

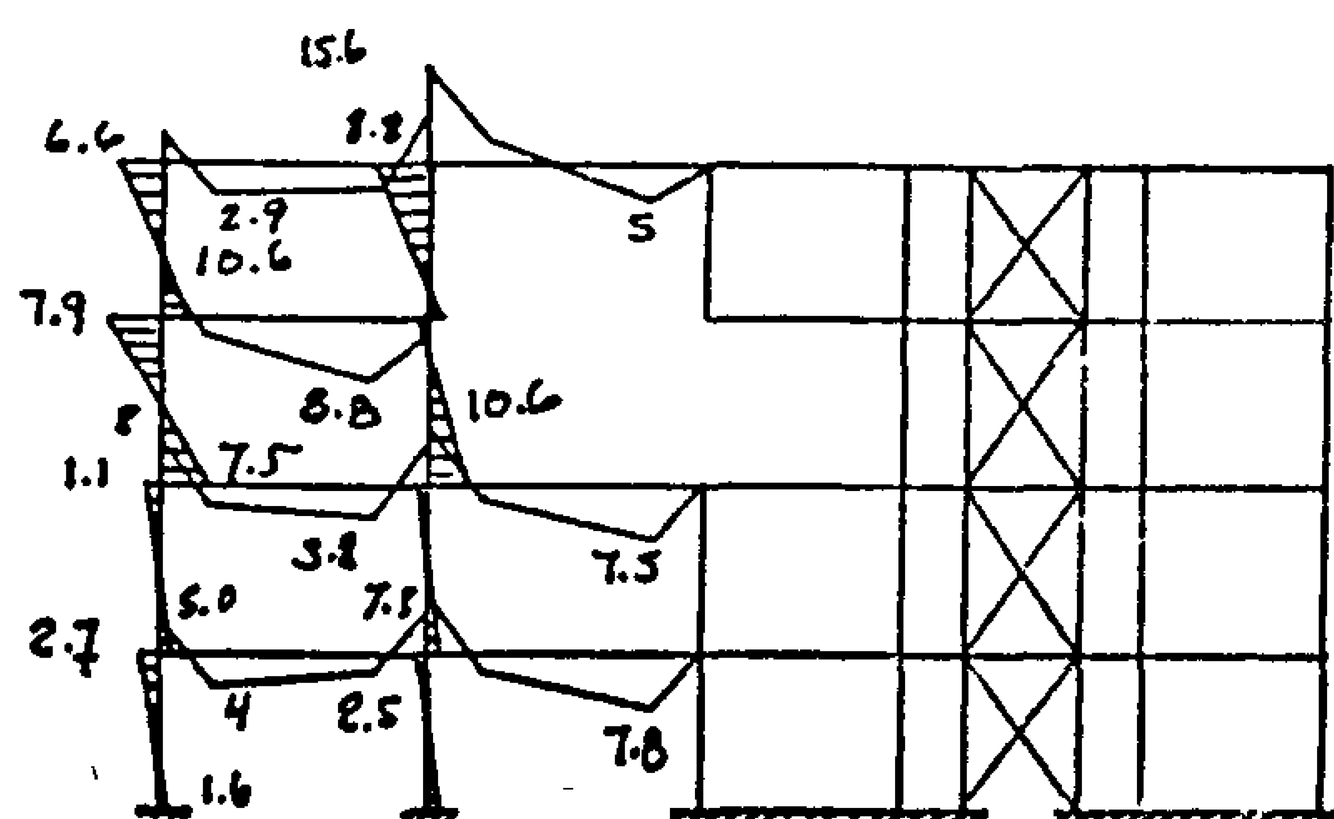


Fig. 3. B) LOAD CASE (A)

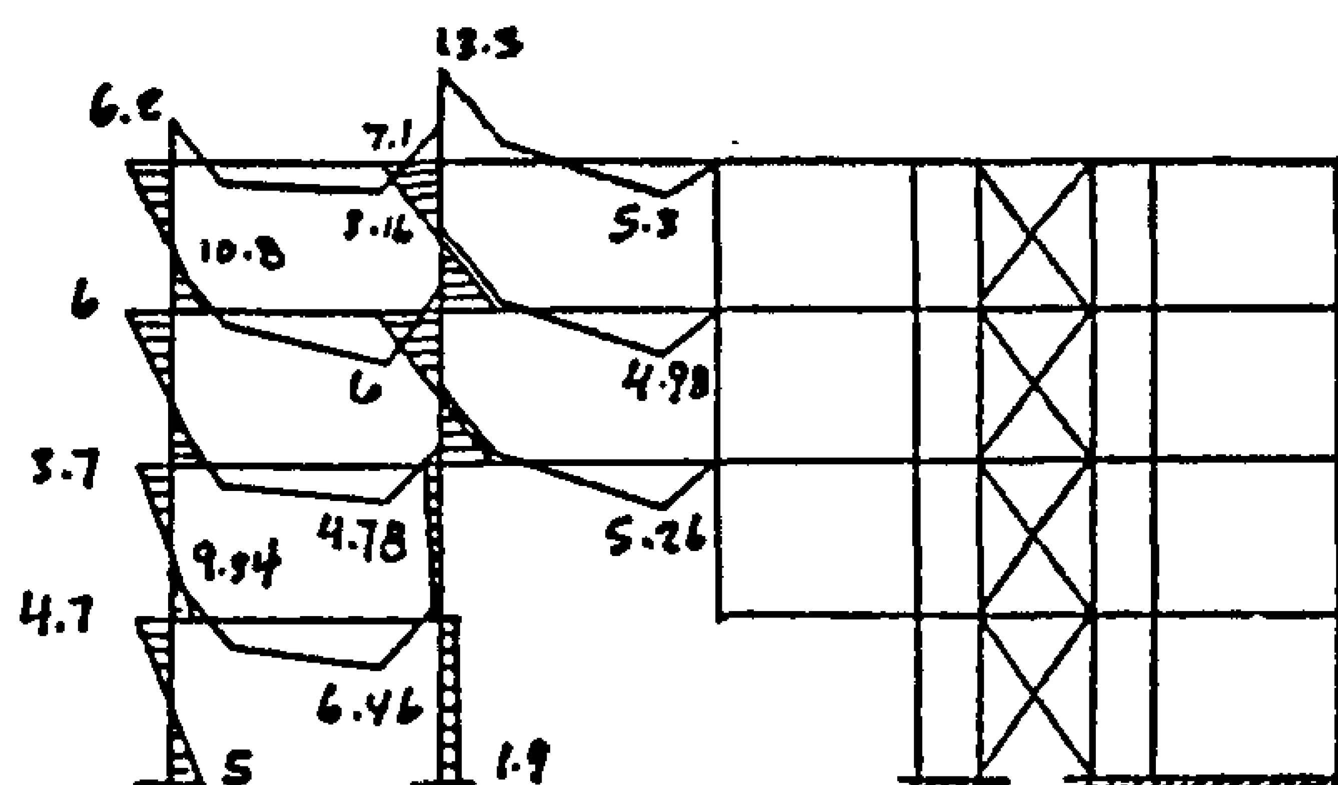


Fig. 3. C) LOAD CASE (B)

Fig. (3) B.M. Distruction for different loading cases

2. In Fig's 4,5, a sudden change of the structural response of the system is observed at the third load stage. At this load level, rupture of the transverse tie occurred. This was associated with a sudden increase in the vertical deflection at the tip of the cantilever section of the wall. The stability of the cantilever section of the wall was maintained by the transvers tie embedded in the joint. This is demonstrated by the increase of the tie force at the load level associated with the tie rupture, Fig. 5.

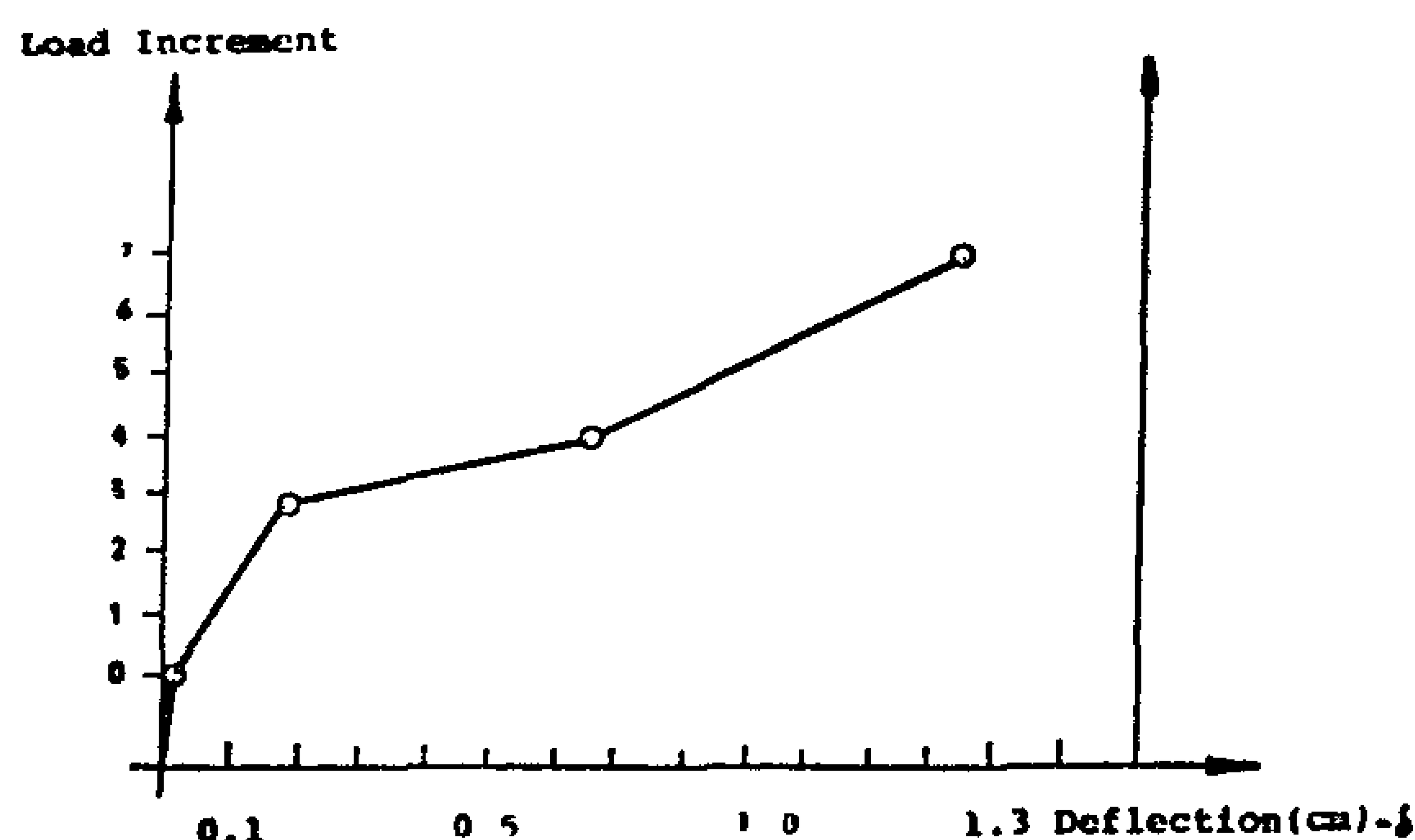


Fig. (4) : Damage portion vertical deflection.

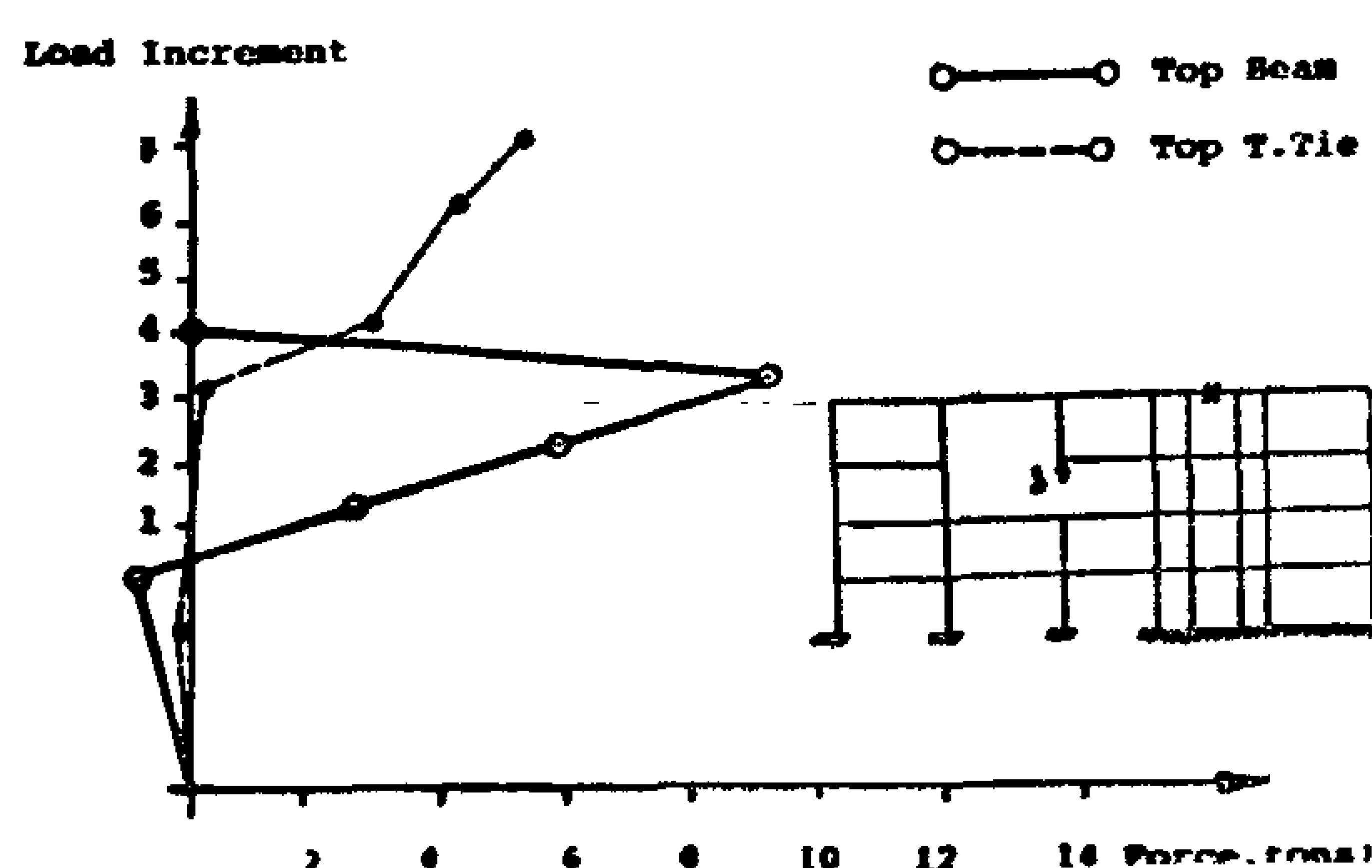


Fig. (5) Top force Vs. Applied loads.

3. In Fig's 6 and 7, normal deformation and shear strength across the horizontal joints are presented. Except for the horizontal joint of the integral column, all loads are transmitted safely to the ground, with regard to the H.J. of the integral column, the normal stresses increased significantly as a result of rupturing the lintel beams. The tensile stresses exceeded the tensile capacity of the joint material, causing opening of the joint. This in turn has resulted significant increase in the compressive stresses compared to the case of simplified analysis in which rotation of the cantilever section is ignored [4]. Axial stresses along the vertical ties embedded across the H.J. of the integral column increased substantially subsequent to supture of the lintel beam. These ties prevented the overturning of the cantilever section of the wall and consequently the overall failure of the structural system.

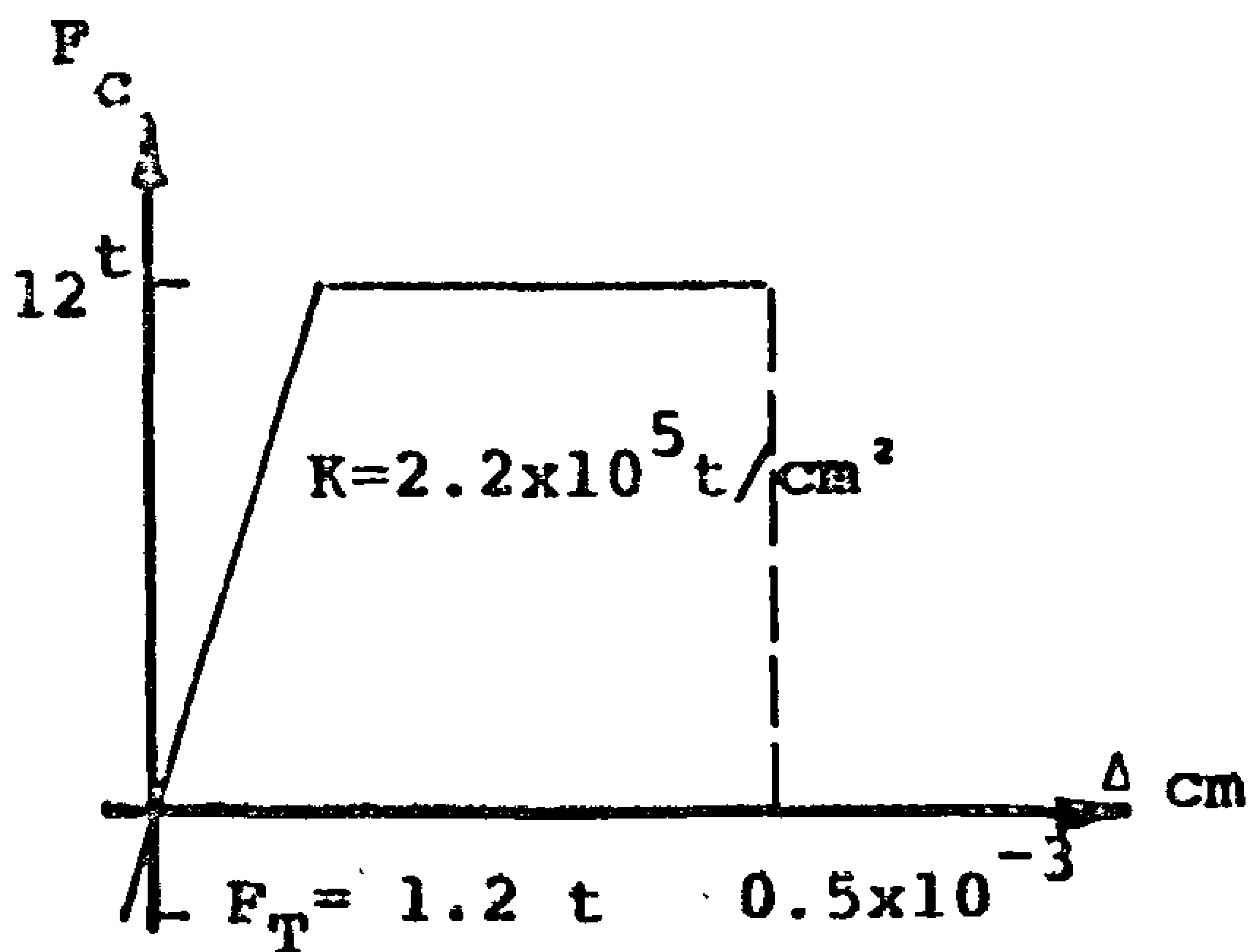


Fig. 2.B) Bearing spring behavioral model

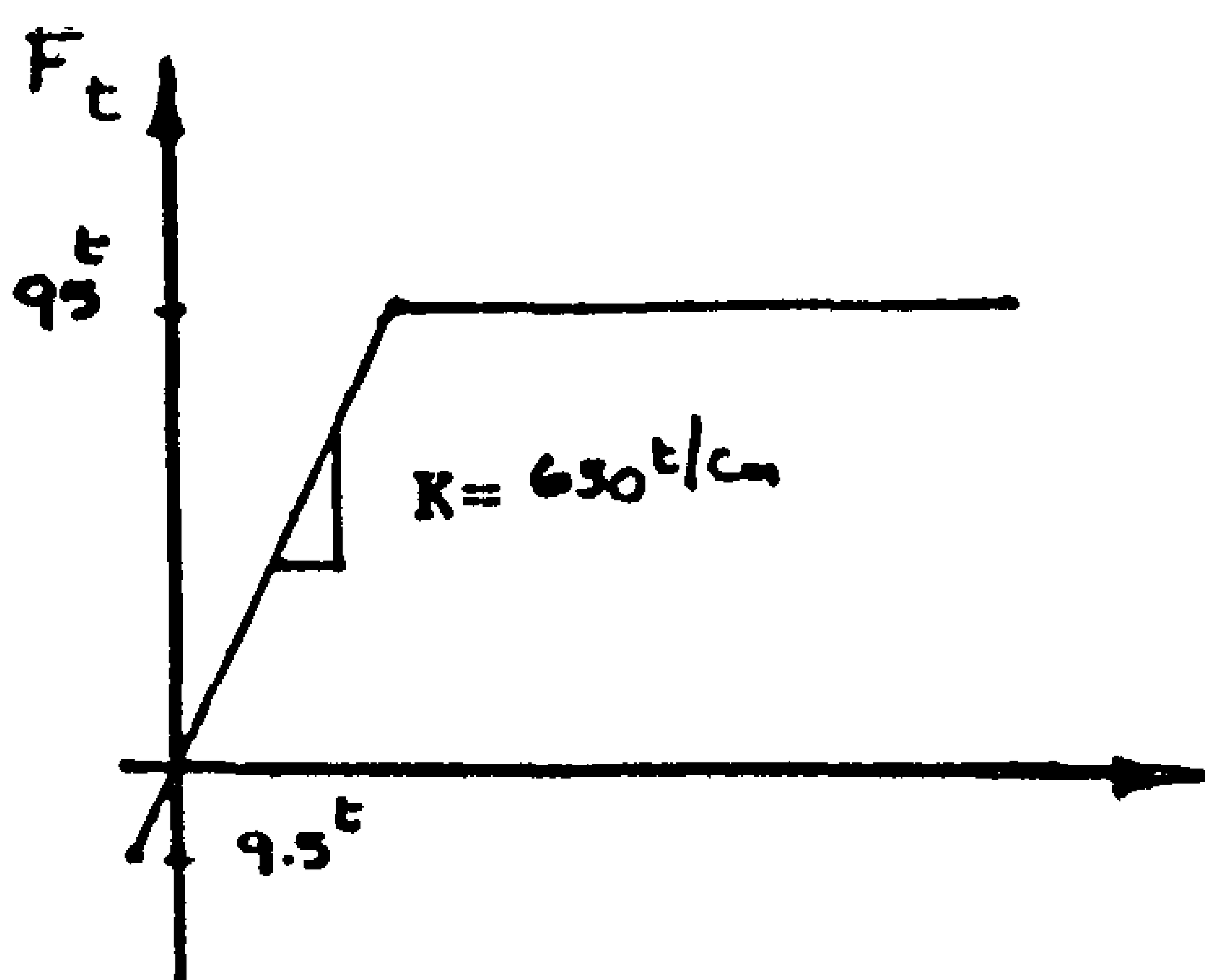


Fig.2. C) Lintel beam behavioral model.

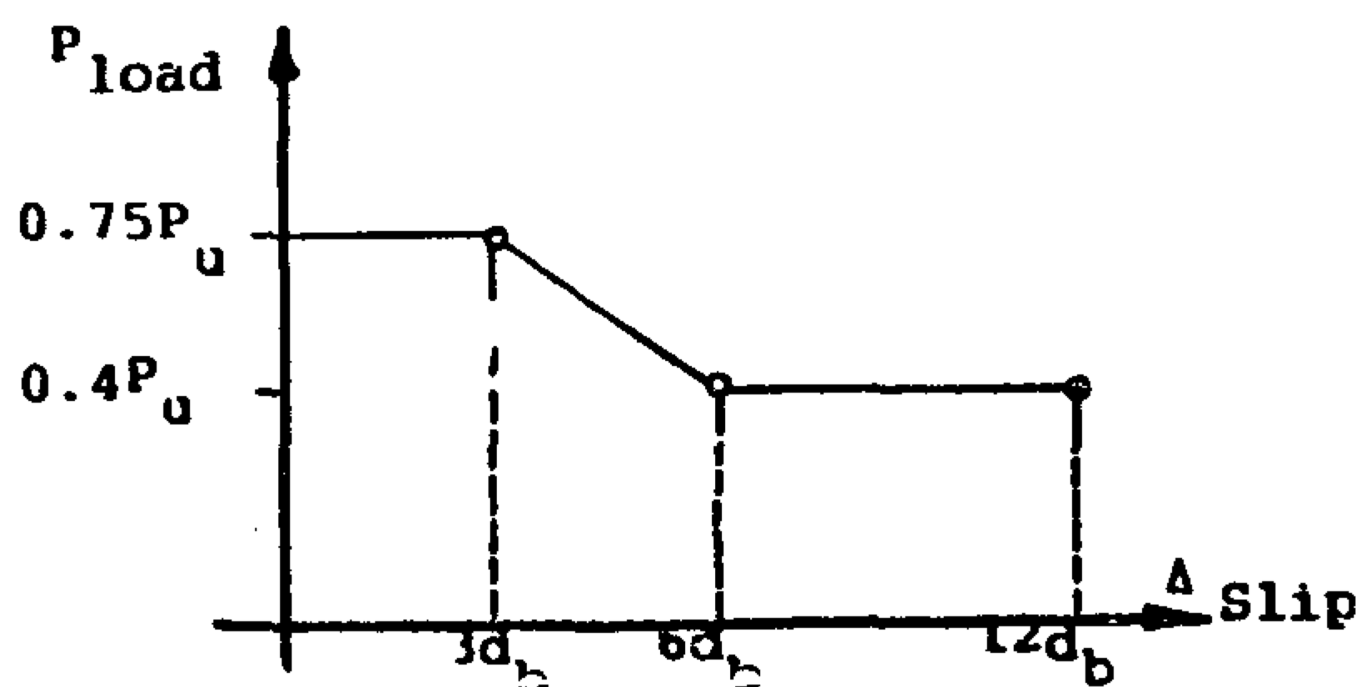


Fig. 2. D) Pull-out slip of transvers ties.

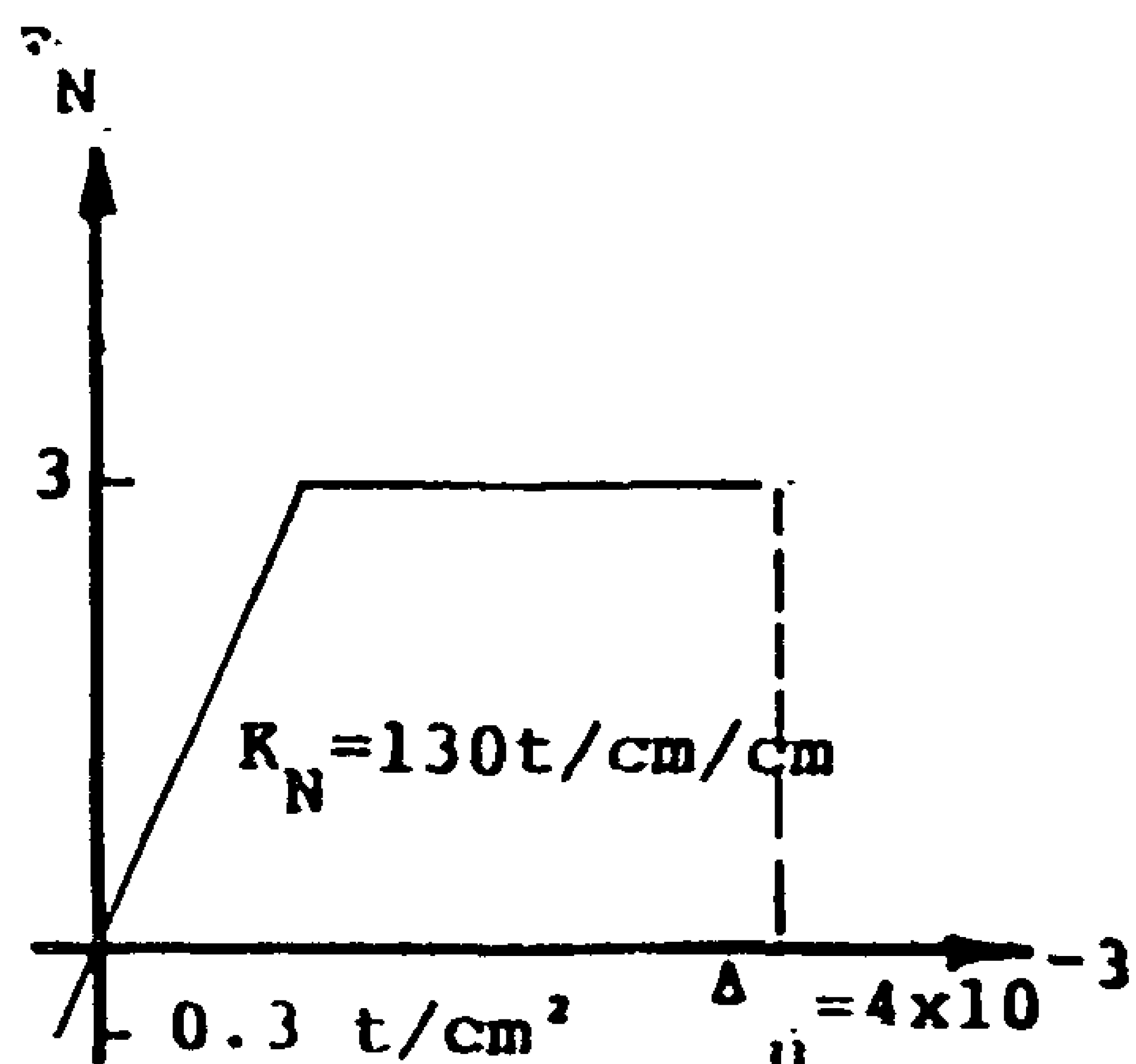


Fig. 2. E) Shear load across horizontal joint.

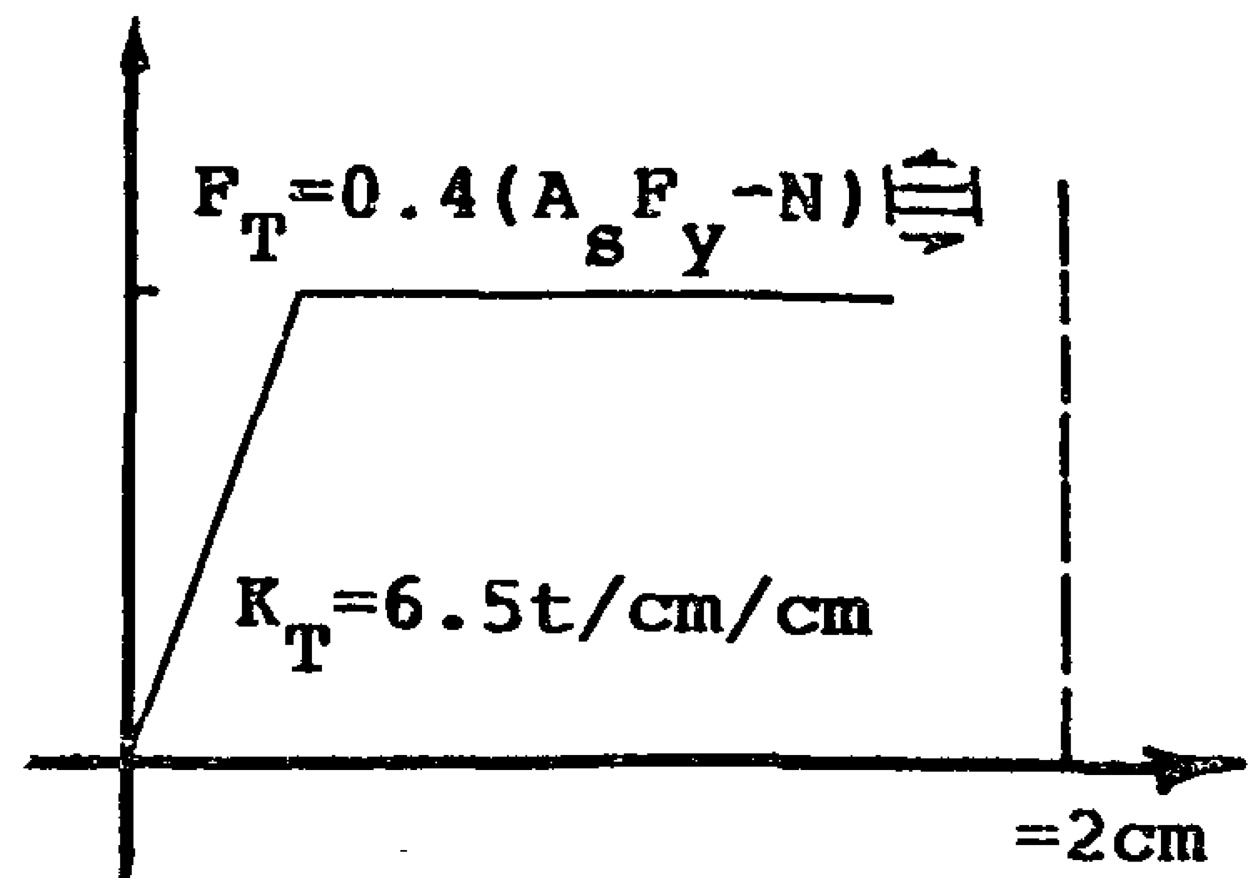


Fig. 2. F) Shear load across horizontal joint.

DISCUSSION OF NUMERICAL RESULTS

The first cycle of analysis was based on analyzing the intact structure under the effect of normal over loads. (i.e, ultimate loads).

In this analysis, the large panel section remained within the elastic range of the material. However; the frame section of the wall experienced some cracking in the tension zone of the beams. The distribution of bending moment is shown in Fig. 3-a. In Figs' 3.b and 3.c, the distributions of B.M. within the frame section of the wall for the post damage structures are shown. Typical results of the large-panel section of the wall are shown in Fig's 4 to 7.

The following conclusions can be made

1. The max. bending moment in the frame section due to normal over loads was in the order of 5 m.t. The max. moment due to the abnormal event was 15.6 m.t, an increase of nearly 200% over the design moment. It should be noted that a linear elastic analysis of the damaged structure would result higher straining actions in the frame section of the wall. Had thes beams not been over designed, overall collopse would have occurred,

applying an abnormal load, beams were assumed to be symmetrically reinforced.

Following the P.C.A. procedure for postulating the effect of an abnormal event [4], two abnormal events occuring separately are simulated. The post-initial damage structures, in both cases, are shown in Figs' 1.b. and 1.c. In order to achieve the stability of the post-initial damage system, it is postulated that damage is limited to the original panel. Each panel is assumed to be provided with an «Integral Column» which is assumed to survive the "Initial Abnormal Event". This "Integral Column" is designed to support the vertical loads which may occur as a result of removing a portion of the panel.

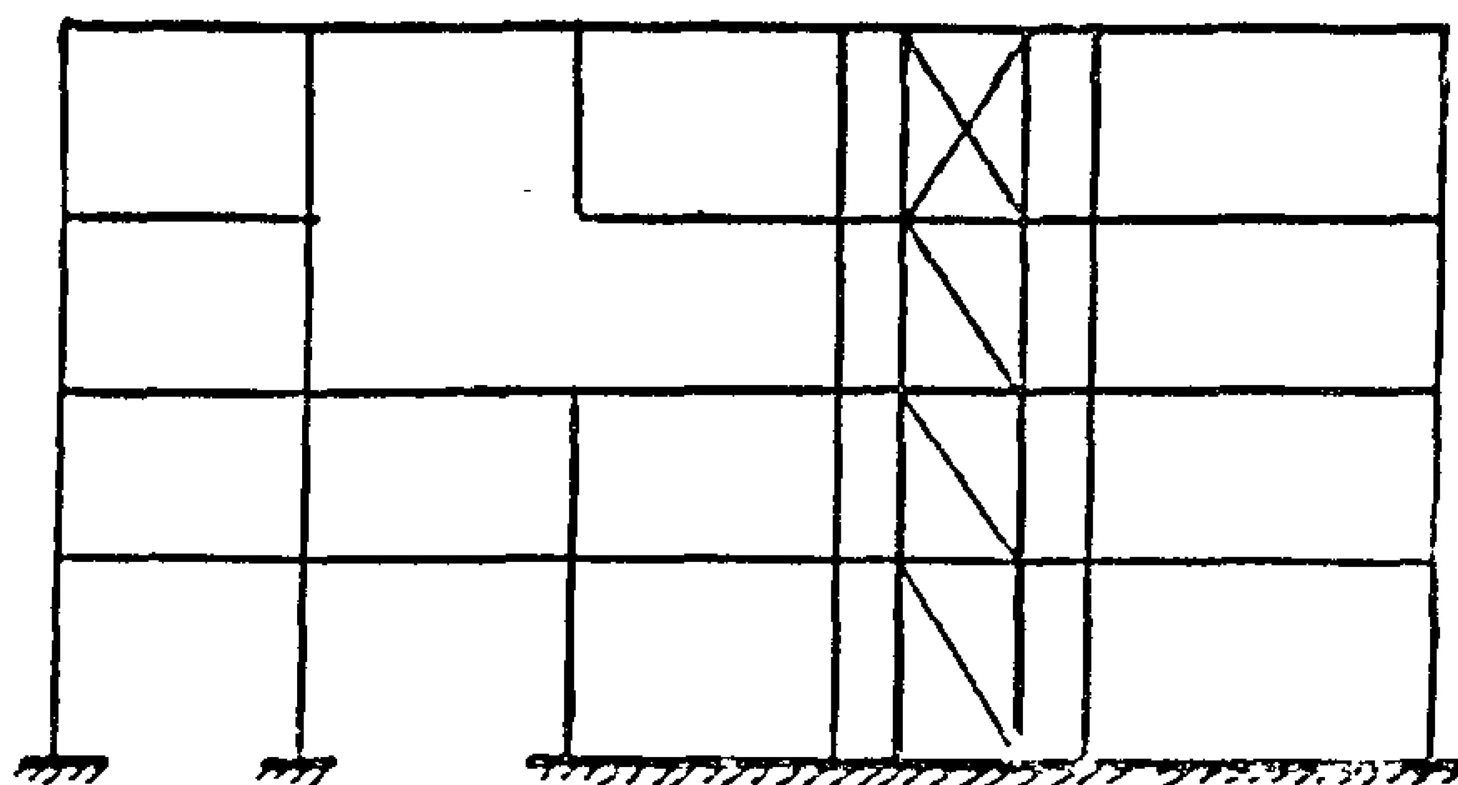


Fig. 1. c) An elevation of the stractural system post an abnormal event-case (A).

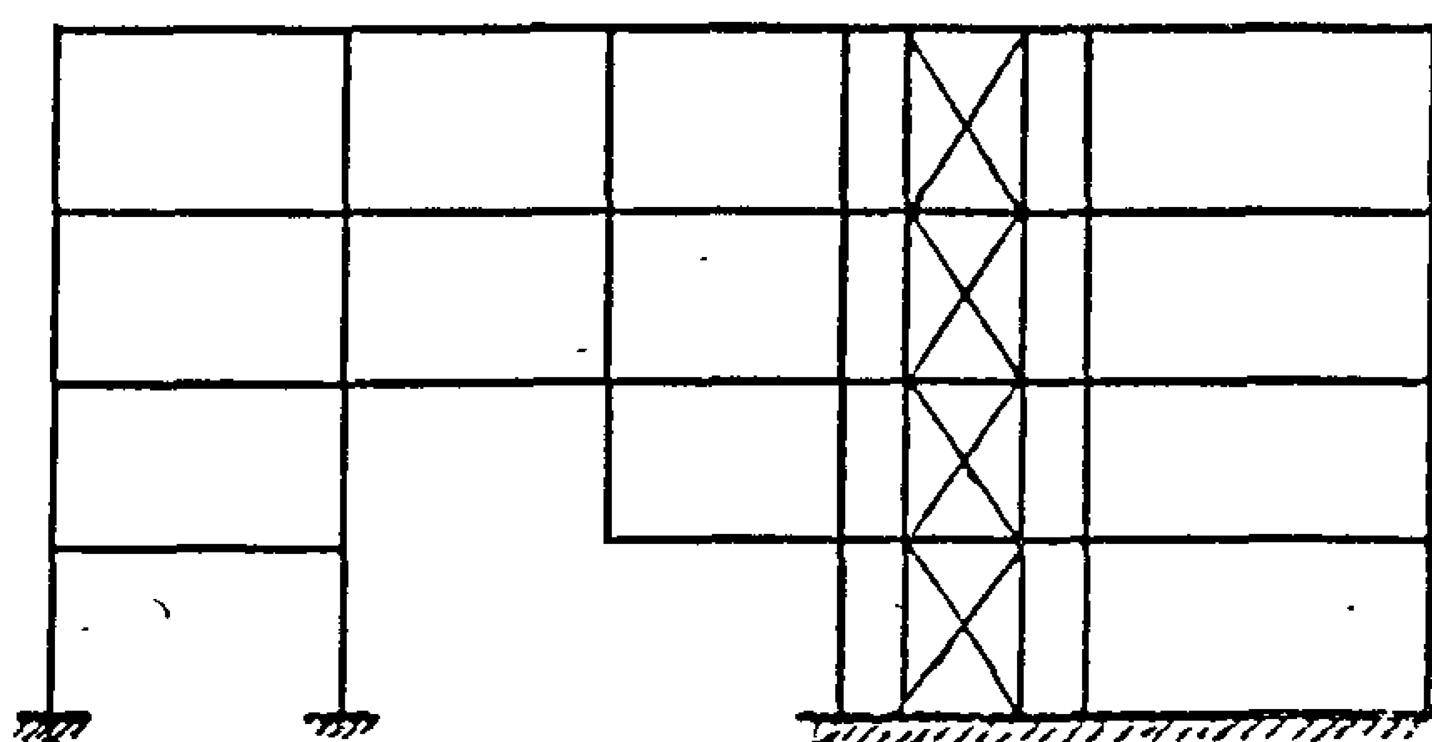


Fig. 1. c) An eleation of the vstructural system post an abnormal event-case (B).

Abnormal events are considered of quasi-static nature. Following the P.C.A. [4], the post initial damage system is to be analyzed to withstand the full dead load + ½ the live load. Considering the nature of loading and properties of the joints between the panels, full loads were assumed existing on the undamaged section of the wall while the dead loads + ½ live load were applied incrementaly on the section surrounding the damaged zone. In this example, loads were applied in seven load increments.

F.E. MODEL

The F.E. method is utilized to analyze the post-initial damage strictural systems. WATANS [2], a computer alogorithm for analysis of sttructures post the eastic range was utilized. The original verision of WATANS was modified and beam element was added Ref. [2].

In WATANS, solution of the non-linear equilibrium equations is based on Modified Newton-Raphoon technique The. algorithm was mounted on an I.B.M. personal computer.

BEHAVIORAL MODELS

A summary of material models is shown in Fig. 2. Two remarks should be made, the first concerns the shear load transfer across the horizontal joint. The joint shear capacity is a function of the normal force transmitted across the joint. The second concerns the pull out - slip of the transverse tie. The tie behavioral model is based on the idealized pull out-slip proposed in Ref. [4]. Values of the models stiffness coefficients were based on those recommednded in the literature.

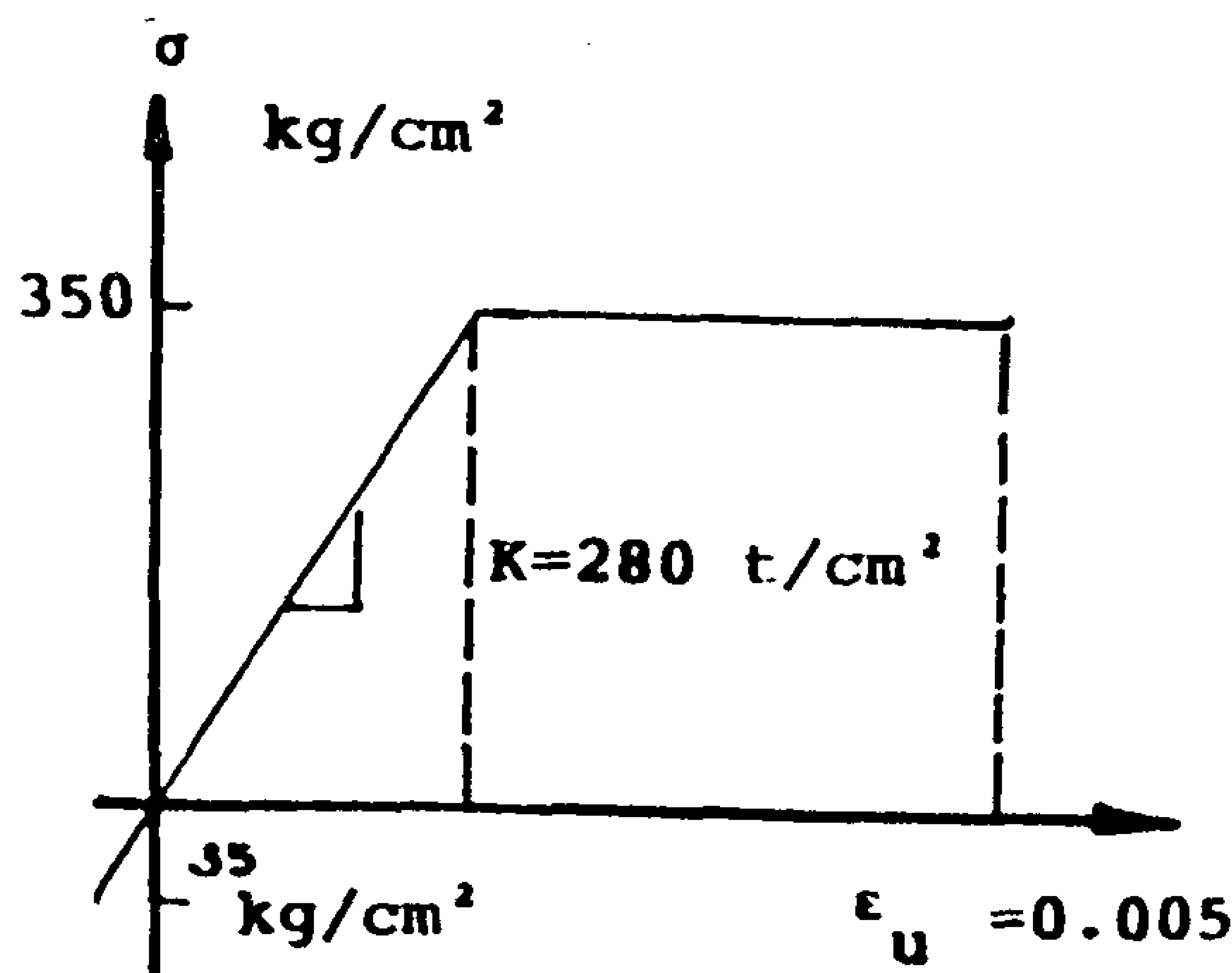


Fig. 2.A) Wall panel behavioral model.

BE.IAVIOR OF PRECAST — LARGE PANEL — FRAME INTERIOR WALLS POST AN ABNORMAL ACCIDENT

Dr. A.H. Anis*

ABSTRACT

Leading research in North America in the late 70'0 and early 80's has clearly demonstrated the lack of structural integrity of precast L.P. structural systems. This in turn has led to introducing significant changes to building codes. As a result, it is now the responsibility of the engineer to design these buildings to withstand abnormal loads and avoid catastrophic failure.

In this article the results of analyzing a four stories, frame-large panel interior wall (i.e. wall with openings) are presented. The analysis is based on the F.E. method. Due to the severe load level, sources of material non-linear response (i.e., joint slip, joint opening, material crushing, and yielding of reinforcement etc.) are incorporated in the model.

INTRODUCTION

An elevation of the wall under investigation is shown in Fig. 1.0. The structural system between axes A and C is a beam-column system while it is a Large panel system between axes D and F. The beam-wall connection is chosen of the simply supported type (i.e., connecting moment is zero).

The Large panel section of the wall is composed of two sides AB and CD connected by Lintel beams. These beams behave as strut members.

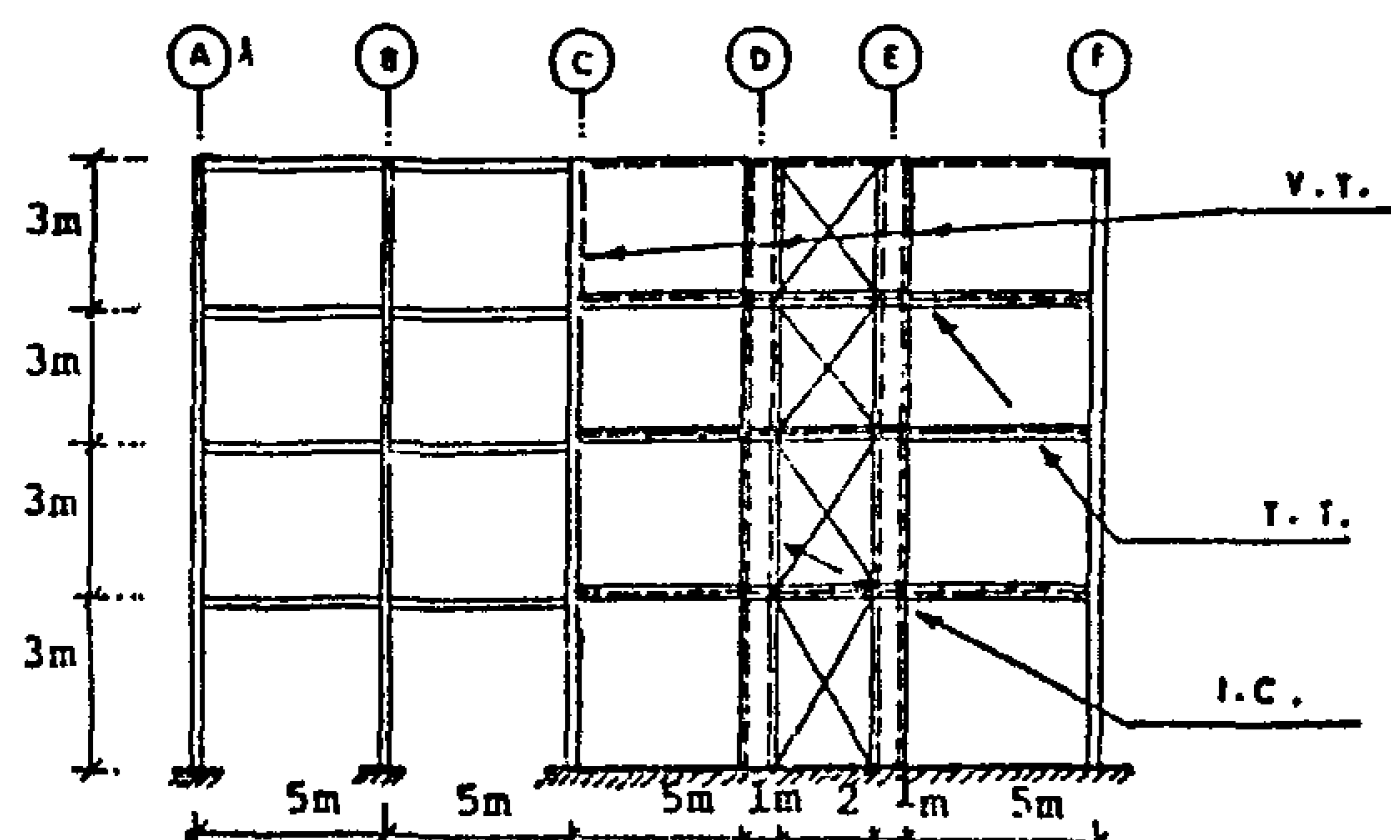


Fig. 1.a) An elevation of the structural system.

The structural system in its intact form was designed originally according to the A.C.I. standard procedure [3]. Using the design approach recommended by the P.C.A. [4], tying reinforcement in the form of horizontal and vertical ties were provided in the large panel section of the wall. Tying reinforcement is as shown in Fig. 1-a.

The sizes and properties of this reinforcement is shown in table 1.0. The horizontal joints are of the North-American open type. Details of materials characteristics utilized in the analysis are shown in table 1.0.

Bearing capacity of the horizontal joint was based on assuming joint formed of a set of elastic columns as in ref. [5]. In anticipation of severe increase in B.M. due to the abnormal Loads, the beams of the frame section of the wall were over designed to sustain the full load-regime. Expecting a reversal of moment due to

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other limiting factor of the building height is the necessity to provide the demanded parking facilities. According to Karfik[11] for each 50 square meters of the overall area of a city or for 30-50% of all employes, a parking place must be provided, which creats a difficult problem mostly because of the increase of the size of the lot caused by parking requirements especially in downtown areas.

Economic Advantage of Tall Buildings.- In spite of the considerable increase of their cost compared with low buildings, tall buildings improve their qualities in many respects. According to Hubka [10], tall buildings have longer life which is important from the economic point of view. Moreover, tall buildings contribute to saving land space for agriculture which is the most urgent world's task today, since millions of people are suffering from hunger and malnutrition. From this point of view, tall buildings will become increasingly more attractive, in spite of the fact that new ways will be sought to secure sufficient quality of food through chemical and biological research and exploitation of the sea.

6. TALL BUILDINGS PERCEPTION AND THE FUTURE

From the thoughts presented and discussed in this paper, it is clear that tall buildings have many advantageous characteristics such as the contribution in the environment esthetics and urbanistic planning, human health, social relationship, amenity and relaxation for grown-up inhabitants, saving land, durability, and so on. On the other hand, tall buildings have disadvatageous characteristics such as their shadow on the surrounding areas, their high costs, sociological, and psychological reactions on children and adults, especially feelings of loneliness, etc. Thus, human response towards tall buildings does not have one tendency but rather different opinious according to the factors or reactions influencing their opinions and their sociocultural background. This response may take different trends in the future according to new influencing factors or changes that might occur.

Although it is difficult to specify the future response according to some expected changes, it can be projected to a limited extent. The author sees that the change in people's perception of tall buildings can be more positive and accepting or negative and rejecting according to the following factors:

1. The future of the city and its function as a place to house poor people moving from rural areas to the city or rich people who escape to the country homes from the confines of their high rise filing cabinets.

2. The progress in conveying the idea of tall buildings as suitable for more different purposes such as schools, theaters, exhibition and assembly halls, among others, which can be done by more advance in their design.

3. Overcoming their technical and urbanistic problems.

4. Decreasing their costs as much as possible.

5. Giving more consideration to man's comfort and the human relationships in their design.

6. The change in the sociocultural background through time.

In spite of the fact that the idea of building high structures is not new, their use as residence is still new. However, new thoughts always need time to have a very mature perception. Hence, the future with many factors to be explored will give the final word.

4. THE PSYCHOLOGICAL IMPLICATIONS OF TALL BUILDINGS

Negative Psychological Sides on Adults and Children.-The trend nowadays in building construction is to over-increase the height. The recent advance in the methods of analysis and design, and the good understanding of the structure behavior besides the availability of new construction materials, lead to reducing the structure weight. At the same time, the masonry walls or other heavy claddings to enclose the structure are not used evenly. The result of the relatively light weight and the very high rise is a very flexible building. Due to the very high rise of the building plus its flexibility, the building may have large wind-induced motions which may degrade the comfort of the occupants. According to Conway[5], the sway and the movement of a tall building cause psychological stresses which vary from occupant to occupant depending on the purpose and the function of using the building and the sociocultural background. In addition, accoding to Chang [4], noise due to wind buffeting a building or acoustic tends to aggravate human's perception of motion. The thought of depending on an elevator for exit to the outside world plus the fear of height may cause psychological discomfort to some people. Francu and Zaloik [7] explain that inhabitants may have a feeling of uneasiness as a result of their accumulation in higher numbers; however, they feel loneliness. Mothers may have a feeling of anxiety on higher floors because of loosing contact with their children on the playground.

According to Chang[4] :

> For economy in design and at the same time meeting the occupant's comfort requirements, it is imperative to approach the problem on a rational basis. It is necessary to study the causes of human discomfort from both physiological and psychological points of view. It is also important to take all the relevant factors into consideration.

However, deflections of tall buildings due to lateral forces can be minimized to ensure the psychological well-being of occupants, without any considerable conservation in desigu or extra consumption of construction materials. This can be achieved by studying carefully the very recent analysis and design techniques.

Positive Psychological Sides on Grown-up People.-To whatever degree a tall building provokes negative psychological reactions, it has some positive psychological advantages; for example, the open view from windows and balconies, the higher chance of contact with others for those who care for it and so on.

5. THE ECONOMIC IMPLICATIONS OF TALL BUILDINGS

High Costs of Tall Buildings.-The total costs of tall buildings are greatly in excess of those low-rise buildings, especially if costs per unit area are examined. Tall buildings have higher initial costs, higher maintenance costs. and take longer to complete than low-rise buildings. According to Karfik[11], the structure of higher-rise dwellings is more expensive because of the need for heavier wind loads resistance and the elevator service plus the resulting loss of floor taken by the elevator batteries which increase with increasing the building height, The number of floors is not so much limited by the possibilities of the structural systems today as by the possibilities of elevator transportation which cannot be improved any more by higher speeds, double deck cabins, etc. The only solution in very tall buildings is changing to another group of elevators on some of the upper floors, a solution which is always costly and a waste of time. An-

air is less polluted and noise effect is reduced. In addition, the higher number of inhabitants justifies intense sanitary equipment.

Negative Social Effect on Adults and Children.- On the contrary, high-rise living is regarded disadvantageous for human health as explained by Francu and Zaloik[7]. Inhabitants of tall buildings are divorced from nature, the earth's soil and greenery; besides, they have less opportunity for physical exercise. They may have an inclination to seclusion at home, and uneasy feeling of ant-hill" or "men-silo" condition of life resulting in neuroses. Children have less opportunity for playing out-doors; moreover, their accumulation in the house or on near playgrounds increases the risk of contagious diseases. In case of elevator disfunction, there is a risk for aged or sick inhabitants, and in case of fire there is difficulty of evacuating the building. Also, vertigo due to height and adors due to plumbing defects are negative effects of high rise living on health.

Staying outdoors in green areas or gardens is very necessary for children from 3-8 years of age who need to be in contact with nature to develop better. The impossibility of gardens due to the irreversible process of urbanization, especially in case of tall buildings, prevents the children from having direct contact with nature.

Positive Social Effect on Grown-up People.- For the grown-up inhabitants, according to Francu and Zaloik[7], high rise living gives greater anonymity, feeling of privacy and escape from social control. They can enjoy pleasant open views from windows and balconies and they increase chance of contacts for those who care for them. In contrast to that, high rise inhabitants feel loneliness and social isolation and poverty of social contacts which increase by the use of elevators. According to Gan [8] :

> The feeling of being imprisoned in these tall buildings, devoted of all colors and textures of living things and constantly exposed to the din of traffic could become a nightmare. Tall buildings cannot blend harmoniously into the landscape, thus spoiling the natural beauty of the environment. Tall buildings tend to be breeding grounds for criminals This charge may be substantial to a certain extent by existing criminal records which shows a relationship between crime rates and building heights.

Although the complexity and difficulty of the social problems due to high rise living, these problems could be overcome through time as well as a careful analysis of the design concepts of tall buildings. According to Hubka [10] :

> It is necessary to respect the human relations in great concentrations of people as only the richness of variations of living forms and mutuality of their functions gives vitality to the human behavior. It is not possible to solve the sociological necessities in an isolated way; i.e., by a deep study of individual problems, but on the contrary by summing up of all the relevant aspects. It is an open problem how to design a high house for a man to feel at home or design in this respect a house for an anonymous user. It is necessary to take into consideration a possibility of a final individual arrangements of flats or working places and the degree of this flexibility has not been designed so far.

by segregation of motor traffic, to create ways for pedestrians to organize and form large complexes by economic concentration of capital, material, work and functions.

Besides, tall buildings allow for concentration of certain types of activities in one house for overcoming the shortening in horizontal paths to certain common equipment and amenities e.g., shops, playgrounds, etc. With the aid of tall buildings, as explained by Francu and Zaloik [7], the advantageous positions in a city can be used for a greater number of users; in addition, orientation points can be created in the city. Moreover, the allowance of condensation of some parts in a city is a means of preservation of natural features of territory such as green areas, water surfaces as lakes, etc.

From the aspect of urban design and planning, these were briefly the advantages of tall buildings; on the contrary, there are many disadvantages that can be summarized in the following, as described by Francu and Zaloik [7] :

1. Tall buildings are unsuitable for functions such as schools, theaters, industry, etc.
2. Cost shadow requires increased distances between buildings.
3. Concentration of inhabitants or users results in increased requirements on adjacent areas; e.g., parking, access roads, playgrounds.
4. Tall buildings are unsuitable for small towns and villages.
5. Increased tact is required for integration of tall buildings in existing parts of cities, especially historic cores of cities.
6. Undesirable competition of tall buildings with buildings of intended emphasis may occur.

Hubka [10] explains that it is characteristic of tall buildings that the upper stories come in touch with the changing climatic conditions, such as increasing speed of wind, which influences not only the bearing structures but also the surface of the building and thermal and climatic conditions inside. The lighter the building, which might be required in many respects, is the greater the danger of vibration. The surface of the building is also more exposed to the effects of wind, frost, sun and rain. Thermal conditions of the building are exposed to sudden changes.

The Shadow due to Tall Buildings.-The penetration of sun rays into tall buildings results in the advantage of solar radiation for a healthy and pleasant environment. However, many people prefer to be protected from direct sun light when they are out of doors. On the other hand, the shading of tall buildings covers the greatest area of the adjecent territory, which may cause a reduction of insulation in the surrounding dwellings. According to Gero [9], many city authorities are aware of this problem, so they requre shadow analysis of buildings proposed around tall buildings. Many streets have suffered in the same way from shadow because city development is a gradual process; consequently, the exclusion of sun light from streets often goes on unnoticeably until it is too late to take action.

3. THE SOCIAL IMPLICATIONS OF TALL BUILDINGS

Positive Effect on Human Health.-High rise living can be considered advantageous regarding human health because of the increased access to solar radiation due to the loose pattern of building layout allowed by the use of tall buildings. Moreover, in the higher parts of the building, according to Francu and Zaloik [7]

4. Land cost that was frequently considered as a factor.

5. The efficiency of vertical transportation as it is only from ten to twelve feet to a new environment.

6. The possibility of the preservation of parks and other green spaces, providing opportunity for needed mental and spiritual renewal.

7. Providing better urban living since the higher concentration can justify more amenities.

8. Sources of safety as in early days; castles on peaks, tree houses, building on stilts. Even today, the engineered tall buildings construction is such that they are more likely safer than low-rise structures from environmental factors.

9. A sense of social power that is probably a remnant of the old defense idea which began with fortresses, then castles.

10. A sense of elevation, prestige, wealth and social position.

2. TALL BUILDINGS AND ENVIRONMENT

Tall Buildings and Environmental Esthetics.-The environment-structure interaction is such an important factor that it must be considered in any urban design. An esthetic environment is one of the results of this interaction. The contribution of tall building structures in achieving this beauty can be realized in their internal and external esthetics. The internal esthetics as described by Beedle [2], mostly rest upon their architect and interior decorator, and there is a unique opportunity in tall buildings because of the relation of the spaces to tallness; for instance, the vistas, the views outside windows or balconies, the externalities that consist of other buildings or land and sea-scape.

The external esthetics can be obtained from the mere size of the building, the facade, the surrounding environment and so on. According to Beedle [2], «if (the tall building) has neighboring buildings of the same height; then, there is the matter of harmony and relationship. If it is taller than its surroundings, it takes a monumental character that provides a challange to the design team». Beedle [2] explains that the use of the reflecting glass, for the purpose of admitting light, forms a facade treatment which represents an important factor of attractiveness, both for the people who work in the building and those who see it. The more efficient use of land allows the opportunity to create an attractive urban environment. Since tall buildings represent a human encounter, it is a good reason to have them in cities where people go either as residents or as visitors.

Tall Buildings and Urbanistic Planning. - Beedle (2) states that the urban design must be considered in the design of tall building regarding its shape, form external treatment, relationship with other structures, facilities and spaces. Particular attention must be given to the culture and the needs of the people served : hence, the structure can serve society more efficiently.

According to Hubka [10] :

> The advantage of a concentrated urbanistic structure lies in saving nature and space for development of the tertial sphere, in a more efficient quicker and simpler traffic system, economic solution of water works sewage disposal and effective utilization of industrial and scientific forms of building. It is possible to achieve a renaissance of pedestrian towns

FACTORS INFLUENCING THE PERCEPTION OF TALL BUILDINGS

Salah El-Din E. El-Metwally[1]

SYNOPSIS

The human response nowadays towards tall buildings ranges from «tall buildings are so frightening and awful that they must be outlawed» to «tall buildings represent such a great human achievement that they can be considered the hope of the future». The author's argumentation for such a phenomenon rests on the fact that people are influenced by many different stimuli which can be classified into environmental, social, psychological and economic aspects. The relation between these aspects and tall buildings are examined in this paper.

1. INTRODUCTION

Definition and Historic Roots. The idea of tall buildings is not new, since many societies have been able to build high structures as seen in the Egyptian Pyramids, Babel Tower, the Mayan Temples of India and Gothic and Rennaissance cathedrals of Europe. According to Amos [1], the motivation for building high, which has changed through time and place, and technical development have given rise to a series of planning considerations of critical importance to both the physical and social environment. In whatever manner, the term «tallness» is still relative; for example, a ten-story tower block in a subrub of two-story houses would certainly be regarded as «tall», whereas the same building in Chicago or Manhatten would be considered «low». Similarly, a building of ten-story height whose horizontal dimensions far exceeds its vertical dimensions, may be regarded as large but might not be thought to be tall. Furthermore, the response towards building height cannot be perceived solely because of the visual height. For example, to the disabled or handicapped, a low building with long flights of steps may represent more problems of height than a much taller building equipped with elevators. However, according to Ford [6], only tall buildings over 328 feet (100 meters) height may be correctly considered as skyscrapers while those under this height and over ten-stories should be considered as high-rise structures.

The Philosphy of Tall Buildings.- Although tall buildings are basically the consequence of industrialization and urbanization and more than one developed country has erected skyscrapers to show how it was advanced, there have been many motivations for building high. The argument or the philosophy for constructing such buildings can be briefly explained, according to Beedle [3], in the following points :

1. The natural urge to build up as can be seen in the Egyptian Pyramids, the Acropolis, the Babel Tower, etc.

2. The nature urge to be at the center of things which may be done by the building function.

3. The ambition and prestige that can be figured out from ancient times construction of higher rise buildings.

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JOURNAL OF THE
EGYPTIAN SOCIETY OF ENGINEERS

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VOL. 27 ISSUE No. 3 1988

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٢٨ شارع رمسيس ـ القاهرة ج٠م٠ع ت ٧٤٠٥٦٩/٧٤٠٤٨٨

المجلد السابع والعشرون : العدد الرابع ١٩٨٨

- تصدر المجلة ربع سنوية .
- ترسل النصوص المطلوب موافقة هيئة التحرير على نشرها باسم السيد / رئيس التحرير . وهو غير مسئول عن فقد أو تلف أى نص .
- تنشر المجلة المقالات التى تسهم فى رفع مستوى العلوم الهندسية وطرق ممارستها .
- تقبل للنشر المقالات بأحدى اللغتين العربية أو الانجليزية على الآلة الكاتبة ومعها ملخص بكل من اللغتين .
- المجلة غير مسئولة عن الأراء والمحتويات التى تنشر وهى تعبر عن كاتبها فقط .
- تذكر أسماء أصحاب المقالة كاملة باللغتين ومعها القابهم العلمية ووظائفهم .
- يراعى الا تتجاوز المقالة ٨ صفحات بالمجلة ، وفى سبيل ذلك يختصر الاشتقاق الرياضى ويستعاض عن الجداول بمنحنيات مرسومة بالحبر الشينى الأسود ، على أن يشغل المنحنى نصف صفحة على الاكثر ولا يشغل صفحة كاملة الا فى حالات استثنائية وسيصغر اى منحنى الى تلك المقاسات .

ويراعى الا يقل ارتفاع الحروف أو الأرقام على المحنيات المنشورة عن ٣ مم بعد التصغير .

- يعنى بذكر المراجع المستقى منها المقال وتصنف تبعا لاسم المؤلف تم العنوان ثم المجلة أو الكتاب وتاريخه .

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جمعية المهندسين المدنيين
جمعية المهندسين المعماريين
جمعية مهندسى الرى

مقومات تطور العمارة المعاصرة

(*) د . سليم صبحى الفقية
(**) د . محمود عبد الهادى الاكيابى

ملخص :

ادت التغيرات الفكرية والاجتماعية والثقافية الى تطوير العمارة باعتبارها تشكيلا تنعكس فيه هذه التغيرات ، وبرزت نتيجة لذلك حركات معمارية وفكر معمارى ابداعى متطور ، تسترشد بالمبادىء والأسس التى تعتمدها حركة المعاصرة فى العمارة وهى البساطة والعقلانية ونظم الانشاء المتطورة والجمع بين مبدأ الوظيفية والخصائص الجمالية من منطلق خلق التوازن الاقتصادى والتقنى .

وقد كانت هذه الحركات المعمارية تجتذب العقول المعمارية الشابة الذين تابعوها ودرسوا افكارها واتجاهاتها ، حيث قام البعض بتقليدها او تطويرها الى الحد الذى كان يؤدى الى ابراز فكر معمارى متطور وحركة معمارية جديدة . وينتهى البحث الى استنباط مقومات تسع لتطور العمارة المعاصرة .

مقدمة :

نقصد بالمعاصرة فى العمارة «Modernism» نتاج الفكر المعمارى ابتداءا من نهاية القرن التاسع عشر وأوائل القرن العشرين ، عندما أصبحت الحاجة ماسة الى ظهور أنماط معمارية جديدة نتيجة لوجود احتياجات وتوافر امكانيات جديدة . فقد أسهمت الثورة الصناعية والتقنية الحديثة فى ايجاد أحاسيس قوية بضرورة التغيير فى النمط المعمارى نتيجة تغيرات فكرية واجتماعية وثقافية باعتبار العمارة تشكيلا تنعكس فيه جميع العناصر الثقافية . وقد أدى ذلك كله الى تطوير جذرى لفن العمارة ، ظهر أول ما ظهر عند مجموعة من الرواد المعماريين .

ويرى بعض الدارسين فى العمارة المعاصرة انها تمثل روح العصر التى انبثقت عن القرن العشرين (شكل ١) ، وانها تمثل كذلك الصراع من اجل مستقبل أفضل فى اطار الثورة العلمية التى واكبت هذا القرن منذ بدايته . فلا عجب اذن بأن توصف مجموعة الرواد المعماريين بـ «Avant-gardes» الذين يتطلعون الى الارتقاء والتقدم ، فالتطور والتجديد هما مقوما المعاصرة ، والتقدم هو معيارها الحقيقى . وما العمارة الا تشكيل فنى يرتبط بالبيئة ارتباطا وثيقا ويستجيب لرغبات المجتمع واحتياجاته ومتطلباته (١) . وأن أى تغيير فى احتياجات المجتمع ومتطلباته لابد أن ينعكس فى العمارة المعاصرة ويتراءى فيها .

وقد كتب بانهام «R. Banham» ـ فى كتابه « عصر الاساتذة » ـ عبارة أجمل فيها رأيه فى العمارة المعاصرة حين قال : « العمارة المعاصرة ماتت ، تحيا العمارة المعاصرة » .
«Modern architecture is dead; long live Modern architecture»

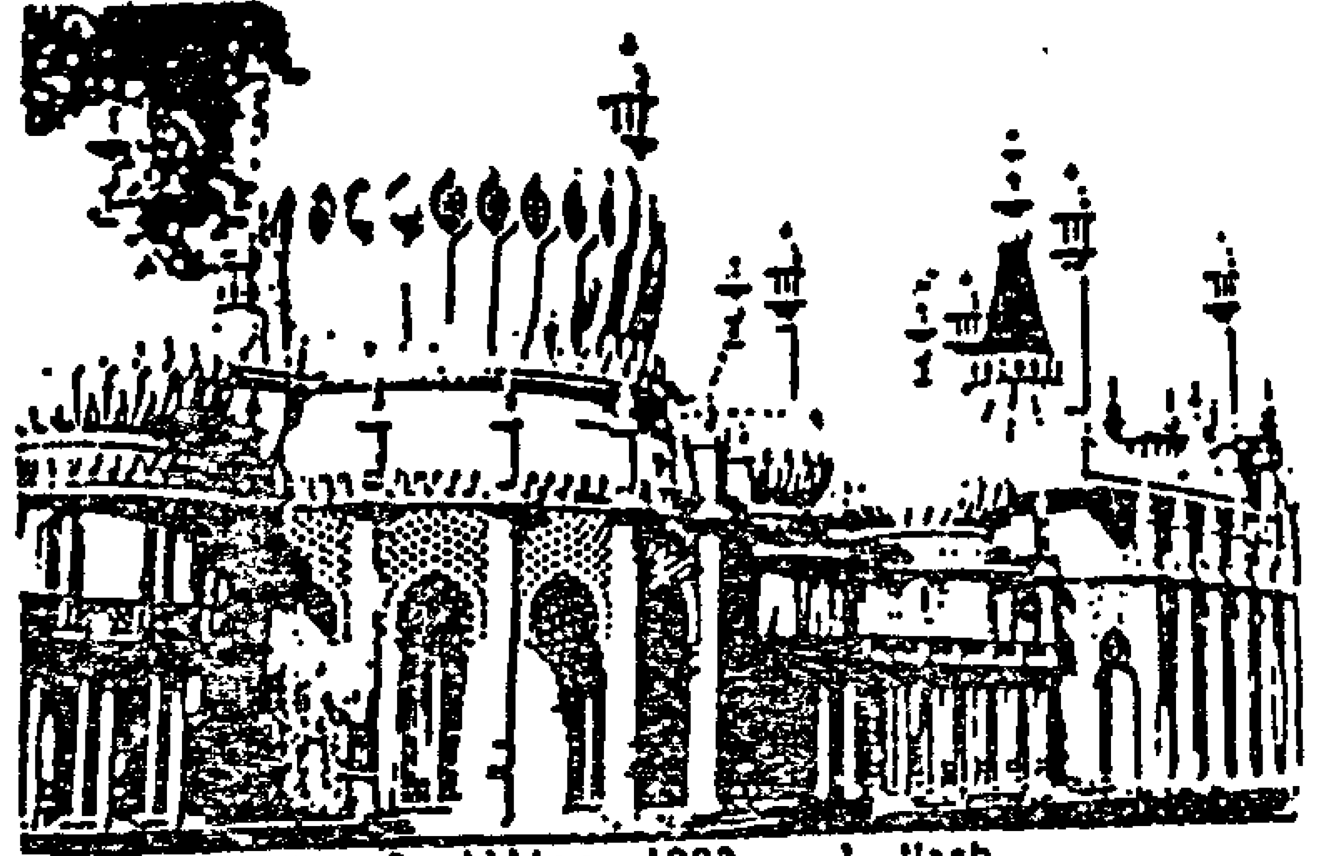
متغيرات المعاصرة فى العمارة

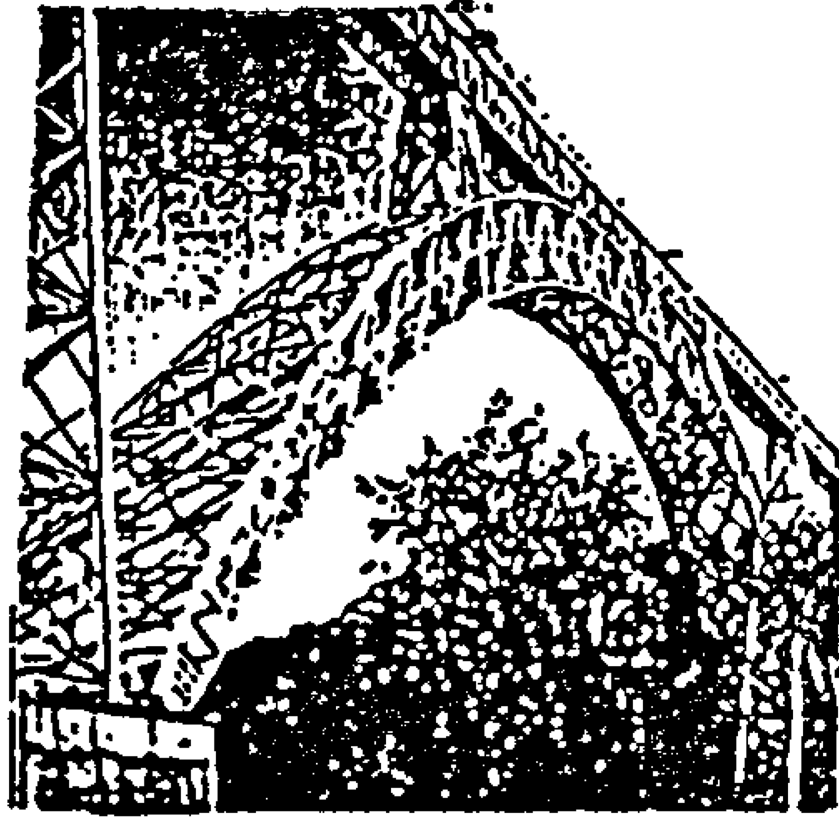
العمارة المعاصرة كما نعرفها الآن تأثرت بمتغيرات القرن العشرين وتجديداته «Regeneration» فهى تغييرات متعددة بنسب متفاوتة ، وتغييرات تقنية مستمرة واقبال من المعماريين على تطوير صناعة الانشاء ، اذ دخلت العمارة فى القرن العشرين عصر التقنية والعلوم أو كما كتب . بويين (٣) C. Boyne على لسان كلارك K. Clark

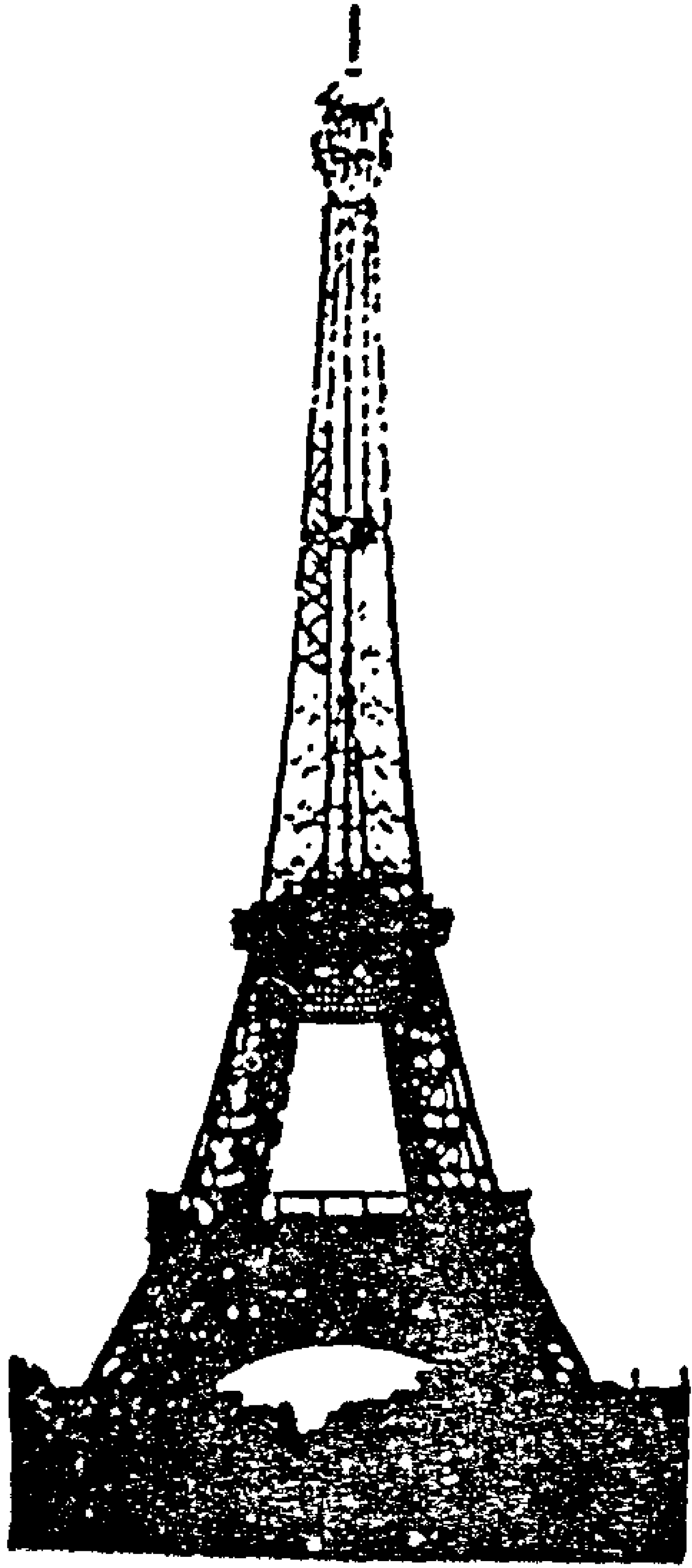
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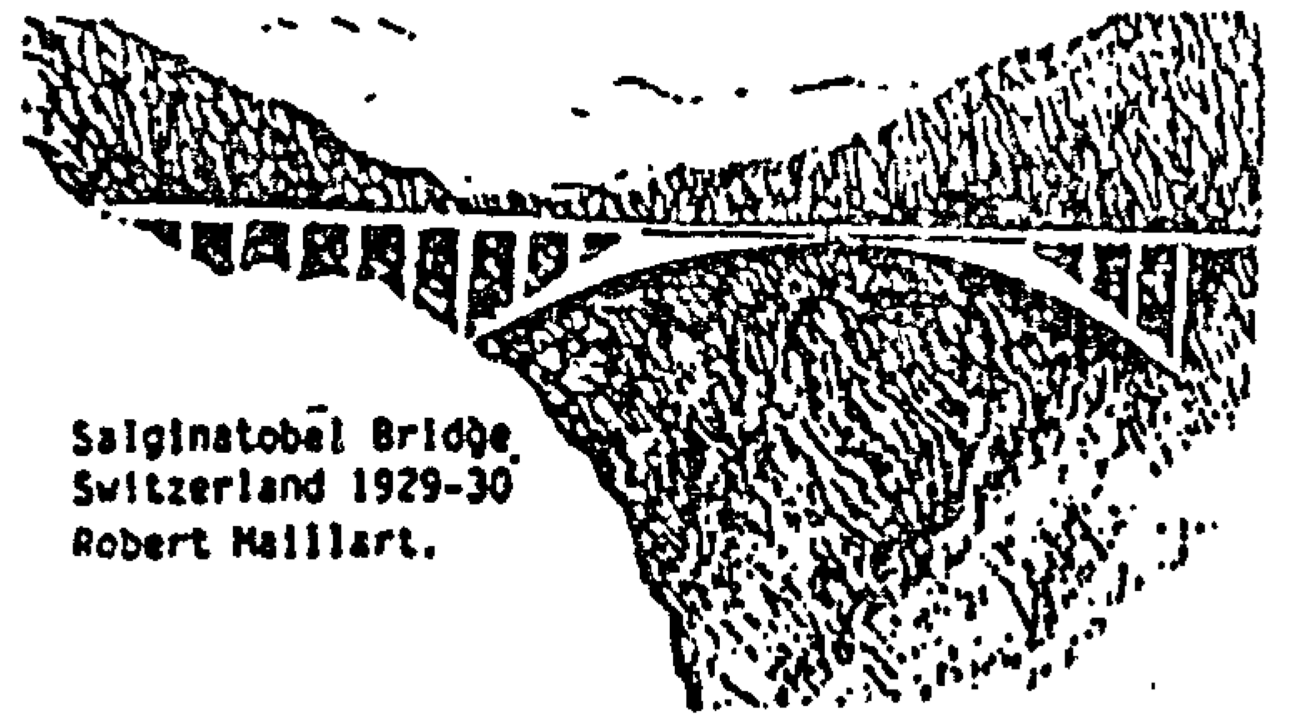
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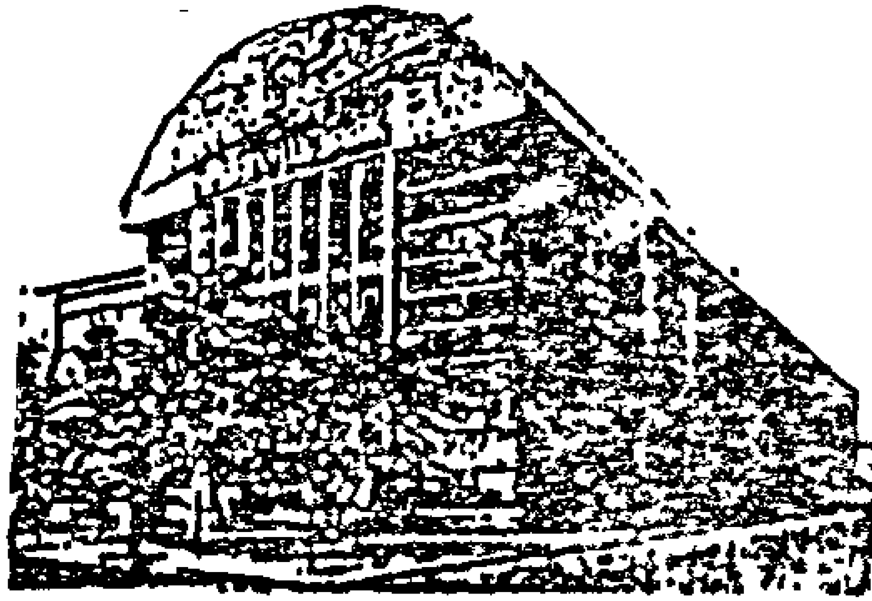
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Brighton Pavillion, 1823 - J. Nash
معرض برايتون - ١٨٢٣ - جون ناش.


Trugere Bridge 1880 جسر ترجير
G. Eiffel


Eiffel Tower - Paris 1889
G. Eiffel
برج ايفل ١٨٨٩


Salginatobel Bridge
Switzerland 1929-30
Robert Maillart.


AEG (Turbine Factory) 1909
P. Behrens
مصنع التربينات - برلين ١٩٠٩
بيتر بهرينز.

شكل (١) التقدم والتطور فى طرق الانشاء

بأنها الفكر القياسى «The Measuring Mind» الذى يتم استنباطه من نقاط أربع هى :

ـ تشكيلات جديدة «New Forms» متأثرة بالحركة الفنية التكعيبية «Cubism» دون زخارف (الأنماط التاريخية) .

ـ مواد جديدة وتقنيات انشائية عصرية متطورة «New Materials and techniques of construction»

ـ الاحساس الجديد بالتشكيلات الفراغية «A New sense of space»

ـ استنباط جديد لمبدا الوظيفة ومعناها «Concept of functionalism.»

وقد أضاف اليها بوين «C. Boyne» (5) نقطتين جديدتين هما : أسلوب البحث العلمى ، والمسئولية الاجتماعية «Scientific research and social responsibility.»

فقد كتب يقول : « وعلى المعمارى أن يتقبل المسئولية الاجتماعية والأخلاقية عن البيئة الانسانية بكاملها » .

هذا وقد كان من نتائج الحربين العالميتين ظهور تغييرات أساسية فى الأساليب الفنية والحياة الاجتماعية فى العالم اجمع وليس فى أوربا وحدها . فقد كتب كلارك «K. Clarke» يقول (٣) : « أن اطار الفكر القياسى قد قدم ولايزال يقدم بعض الانجازات الضخمة للانسانية وهذه الانجازات ليست ممثلة بالعلوم فقط ، اذ انها تتمثل كذلك بمبدأ تقديم الخير الكثير لأكبر عدد ، والذى اذا أقيم على أسس احصائية علمية فقط تحول الى علم اجتماع بيد أن هذا قتل للفن ، اذ أن الفن لا يمكن أن يخضع للقياس » .

وقد كان لظهور المتطلبات الانسانية الجديدة والتشكيلات الفراغية المناسبة لها وتطور الاحساس بالتشكيل والفراغ «Forme and Space» انعكاس على الحياة الاجتماعية . ونتيجة لهذه التغييرات ، تركت العمارة أسلوبها الكلاسيكى ، ومن خلال البحث العلمى ظهرت اكتشافات جديدة وتقنيات تطبيقية بديلة . وتقول آن جريزولد (٤) «Anne Griswald» ـ نقلا عن فوسيلون «Focilon» ـ : « العمارة تعبير عن تطلعات المجتمع سواء اكان هذا المجتمع غنيا أم فقيرا ويجب أن تكون طبقا لبرنامج متطلبات المبنى والمؤثرات المناخية

الخاصة ، وذلك لكى تستجيب المبانى لمتطلبات الجماعة وذلك حتى فى حالة المساكن الخاصة ، فالعمارة تلبى احتياجات معينة لتظهر متطلبات جديدة لأنها توجد عالمها الذاتى » .

ومن حين الى آخر ، كانت تبرز عمارة جديدة لها نظرياتها واسسها ، ثم تظهر حركة معمارية اخرى تتمثل فى تقديم تقنيات متقدمة عن طريق البحث والاعلام، وقد انتهت بعض هذه الحركات المعمارية فى « مستودع انقاض العمارة » «Scrap heap of architecture» بينما قدم بعضها الآخر عمارة ذات انماط ابداعية . ونجاح الحركات المعمارية او فشلها يعتمد اساسا على انماط منتقاة من بين اشكال وانظمة مستنبطة من تركيبات بالغة التعقيد والتداخل «Over whelming complexity» ومن شأن هذه التشكيلات أن تدعم احيانا بعض الآراء والانماط المعمارية التى برزت نتيجة صراعات ومنافسات بين حركات معمارية تغلب بعضها على بعضها الآخر .

الطراز العالمى «International Style» وما بعده

أعتبر بعض الدارسين ان الطراز العالمى «International Style» ــ هو المحتوى الحقيقى لمستوى الفكر المعمارى ومفهومه العام . ومن عادة رجال الصحافة والمؤرخين البحث باستمرار عن كل جديد فى الفكر المعمارى . وهكذا يجد المعماريون انفسهم امام قضايا معمارية جديدة فى فلسفتها وتركيباتها ووظائفها كما قال بوين (٣) «C. Boyne» « .. وعند موت حركة معمارية معاصرة تكون الحركة المعاصرة ولدت من جديد » .

فعندما انتهت حركتى المستقبلية «Futurism» ــ والتعبيرية «Expressionism» انتهت حقبة ثلاثين عاما من فكر وفلسفة معينة، نتيجة ظهور تيارات فكرية معمارية وظيفية متطورة .

وعندما ظهرت حركة الوظيفية «Functionalism» صارت المبانى تنشأ من اجل اغراضها الوظيفية وكان الكثيرون من المعماريين قد تركوا البساطة «Simplicity» ولجأوا الى العضوية «Organic» والنمط الاقتباسى «Eclecticism» حيث اشار الى ذلك بليك (٥) «P. Blake» : « ان التعقيدات العضوية سوف تنتج اكثر انواع العمارة ملاءمة » .

الا أن المعمارى ميس فان دير روه «Mies Van der Rohe» ــ لم يتبين مبدأ البساطة على أساس انها البديل الفعلى لحركة الوظيفية او غيرها من الحركات المعمارية ، ولكن على أساس معارضته للنمط الاقتباسى للمنمنات الذى انتشر فى نهاية القرن التاسع عشر (٥) .

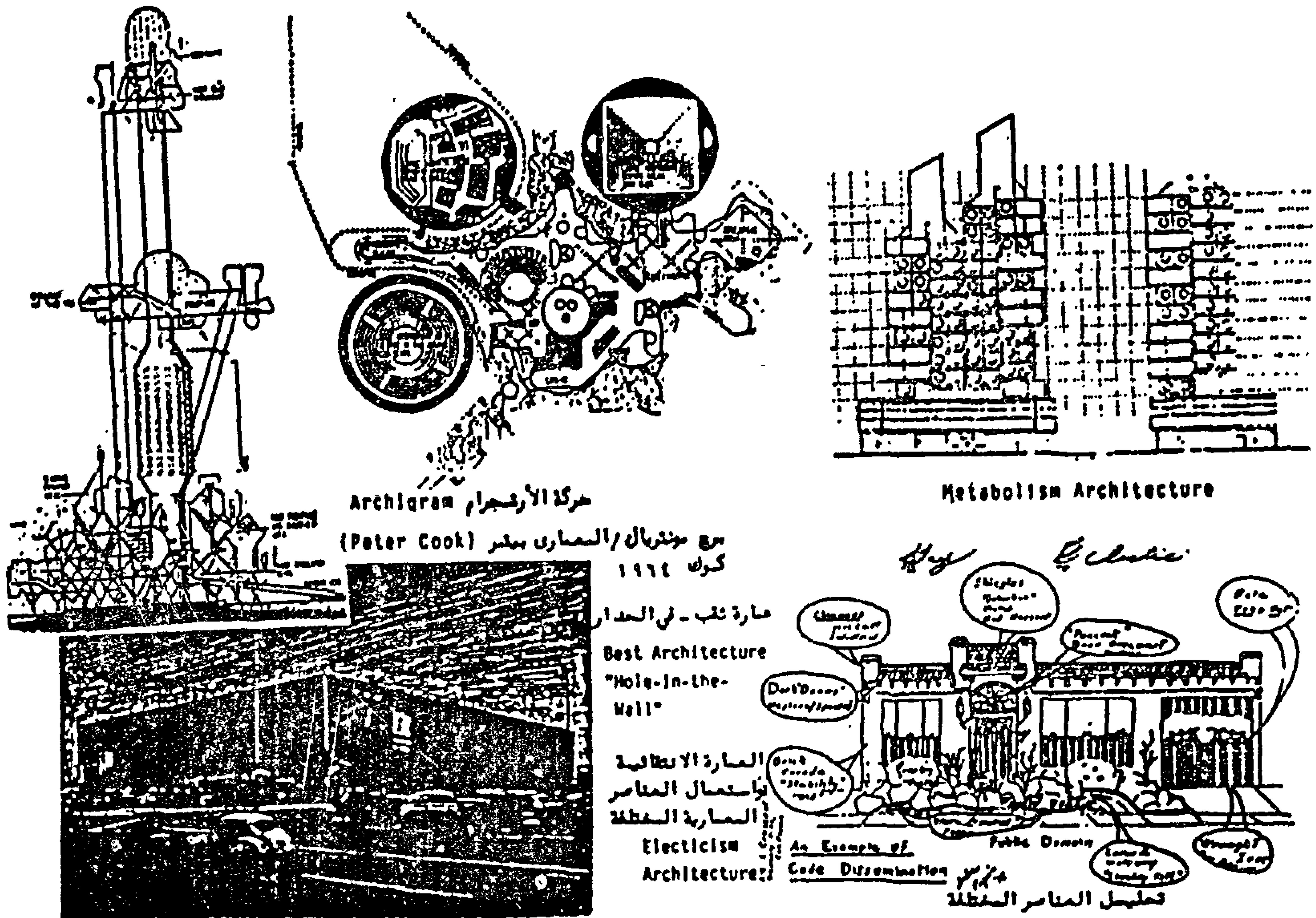
وكانت هذه البساطة ظهور فكرة المسقط الحر «Free Plan» باستعمال تقنيات ومواد جديدة ومتطلبات وظيفية متغيرة ، اضافة الى أن مبدأ الوظيفية يؤكد النظريات والتحليلات التى تبين العلاقة الوثيقة بين الفن والعلم وبظهور الحركة الانسانية «Humanism» ظهرت انماط معمارية تختلف فى طبيعتها الفكرية وتتكامل فى تعبيراتها الوظيفية كما هو الحال فى اعمال المعمارى الفر آلتو «Alvar Aalto»

وحين ظهرت حركة الارشجرام «Archigram» لم تلق تقبلا واسعا نظرا لابرازها مواضيع فكرية لا تتمشى مع التطبيق المعمارى ولأنها بحثت فى تقنيات مبالغ فيها بشكل متطرف فيما يشبه الخيال العلمى «Science Fiction» من الناحيتين العلمية والفنية ، حتى أن تأثير ومساهمة هذه الحركة فى الفكر المعمارى المعاصر وتقنيات البناء الممكنة فى ذلك الوقت تكاد لا تذكر .

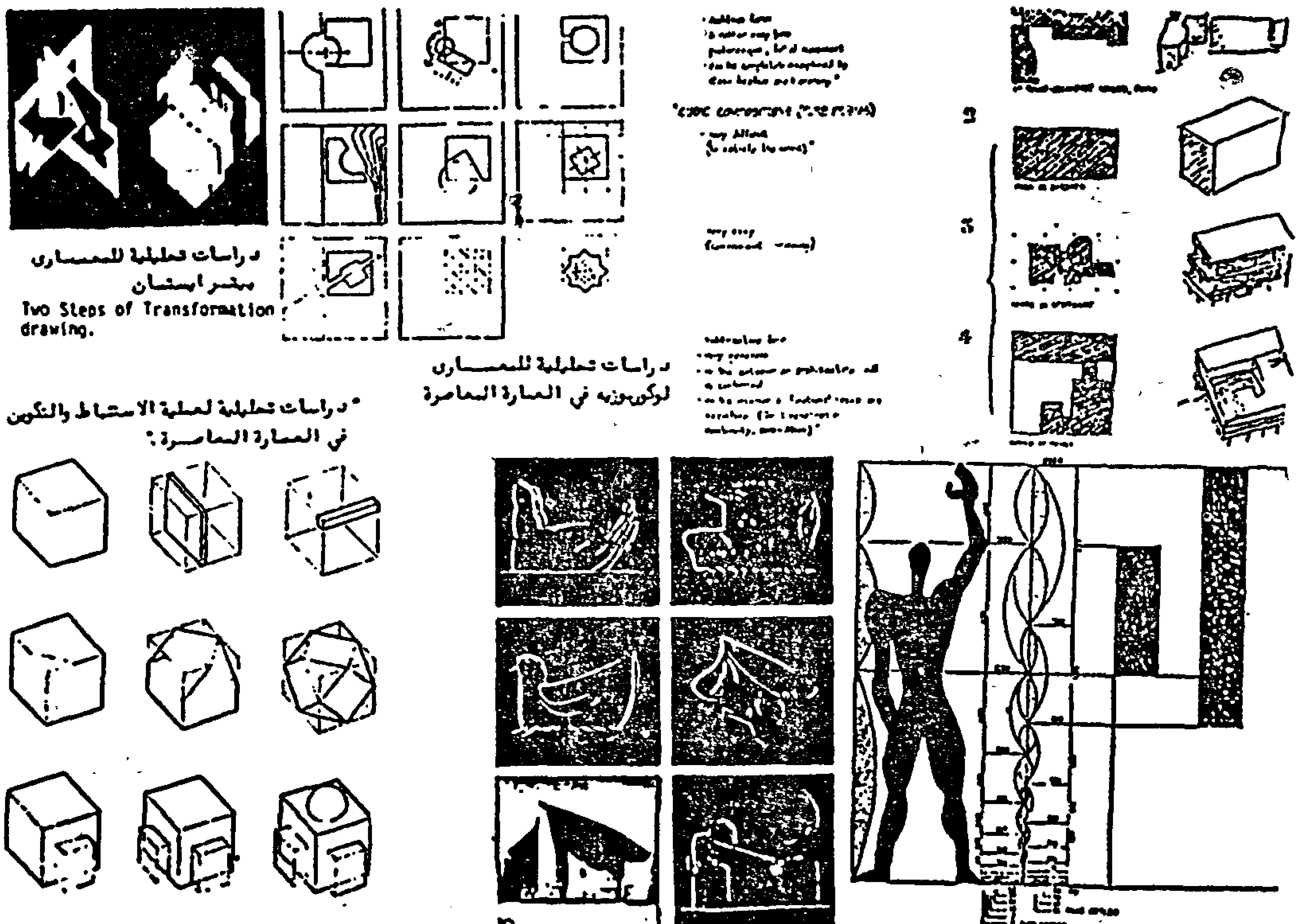
لكن حركة البناء والتطوير فى عمارة التفاعل الحى "Metabolism" حاولت وضع تحليلات بديلة للعمارة ، باستعمال نظريات بيولوجية بدلا من التحليلات الميكانيكية بأفكار تجريبية متبادلة مع حركة الارشجرام «Archigram» فى نهاية الخمسينات ، ووضعت حلولا متناقضة وفريدة فى نوعها لكل فكرة معمارية جديدة مما دعا كولينز (٦) «P. Collins» ان يطلق على هذه الحركة اسم « عمارة اثرية غير قابلة للتصنيف » «archeologically unclassifiedable architecture» واعتبر كولنز جيمس واين «J. Wine» مبتدع فكرة « فتحة فى الحائط «hole-in-the-Wall» ان العمارة طرفة يتلمسها الناس بروح الدعابة (شكل ١٢ ، شكل ٢ب) .

فمن الواضح أن العديد من المهندسين المعماريين انفسهم قد غيروا وطوروا تصميماتهم وافكارهم المعمارية باستعمال أسس جديدة تختلف فى مضمونها عن تلك المبادىء والمرتكزات للحركات المعمارية التى قاموا انفسهم بوضعها . وقد ترك تدخل أصحاب العمل ــ المالكين ــ من افراد ومؤسسات وشركات كبرى فى مقايضات

(شكل ٢ ــ أ) الحركات المعمارية المعاصرة الارشجرام ــ الميتابولزم والانتقائية



(شكل ٢ ب) دراسات تحليلية فى العمارة المعاصرة



مع المعماريين أثرا كبيرا فى توجيه الانتاج المعمارى ، وأصبح من الصعب التمييز بين ما هو تجارى وما هو غير تجارى . وليس لدى معماريى العصر من نسق مشترك سوى أنهم يسترشدون بالمبادىء والأسس التى اعتمدتها الحركة المعاصرة .

ما بعد المعاصرة والتغيرات العقلانية :

هذا وان البدائل المتعددة التى نطلق عليها الحركات المعمارية «Architectural Movements» تعمل باستمرار فى مواجهة التغيير المستمر فى احتياجات المجتمع الانسانى ولكن يحق لنا ان نتساءل : هل استطاعت العمارة المعاصرة تقديم ما يسمى بالحلول المثالية ؟! لاشك فى أن الفكر المعمارى يواجه باستمرار حالة من عدم الاستقرار فى البحث واستنباط الحلول للمستجدات فى عالم الانسان .

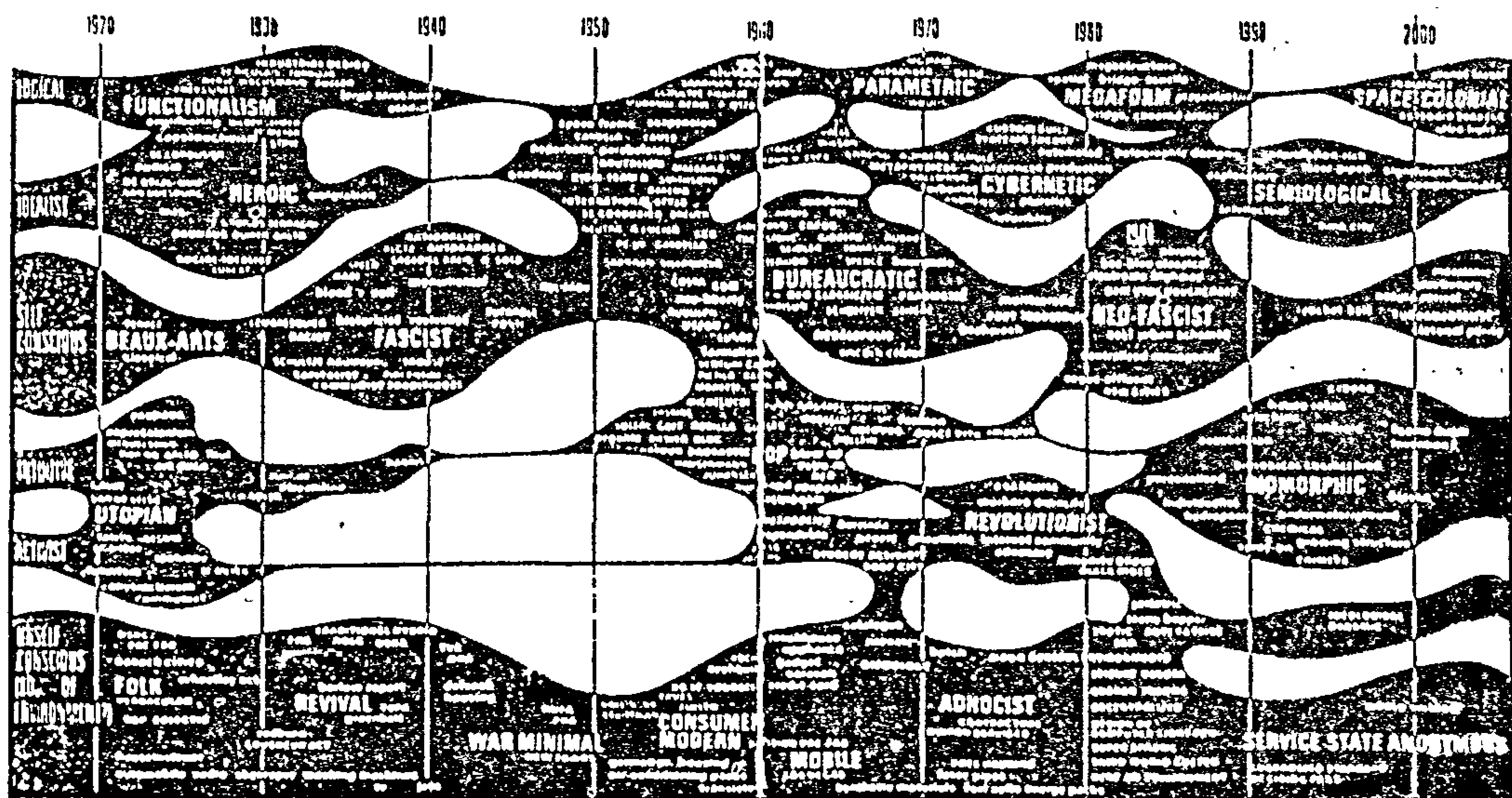
الخلاصة :

وتعد العمارة فى القرن العشرين « عمارة معاصرة » للأسباب التالية :

١ – انها معاصرة فى عقلانيتها «Rationality» وانفصالها عن تاريخ الفردية (٧) «historical intense individualism» فالعمارة المعاصرة أصبحت اعتقادا تقليديا «Conventional belief» لدى جمهور المؤرخين المعماريين وعامة الناس بضرورة التوحيد بين النظرية والتطبيق «theory and practice» . لذا فانه من الصعب تحديد زمن حقيقى لبدء العمارة المعاصرة وذلك لأن الطريقة التى يؤثر فيها المعماريون فى هذا العصر على الأجيال اللاحقة من المعماريين تتمثل فى معارضتهم للتوجيهات الجديدة فى الفكر المعمارى .

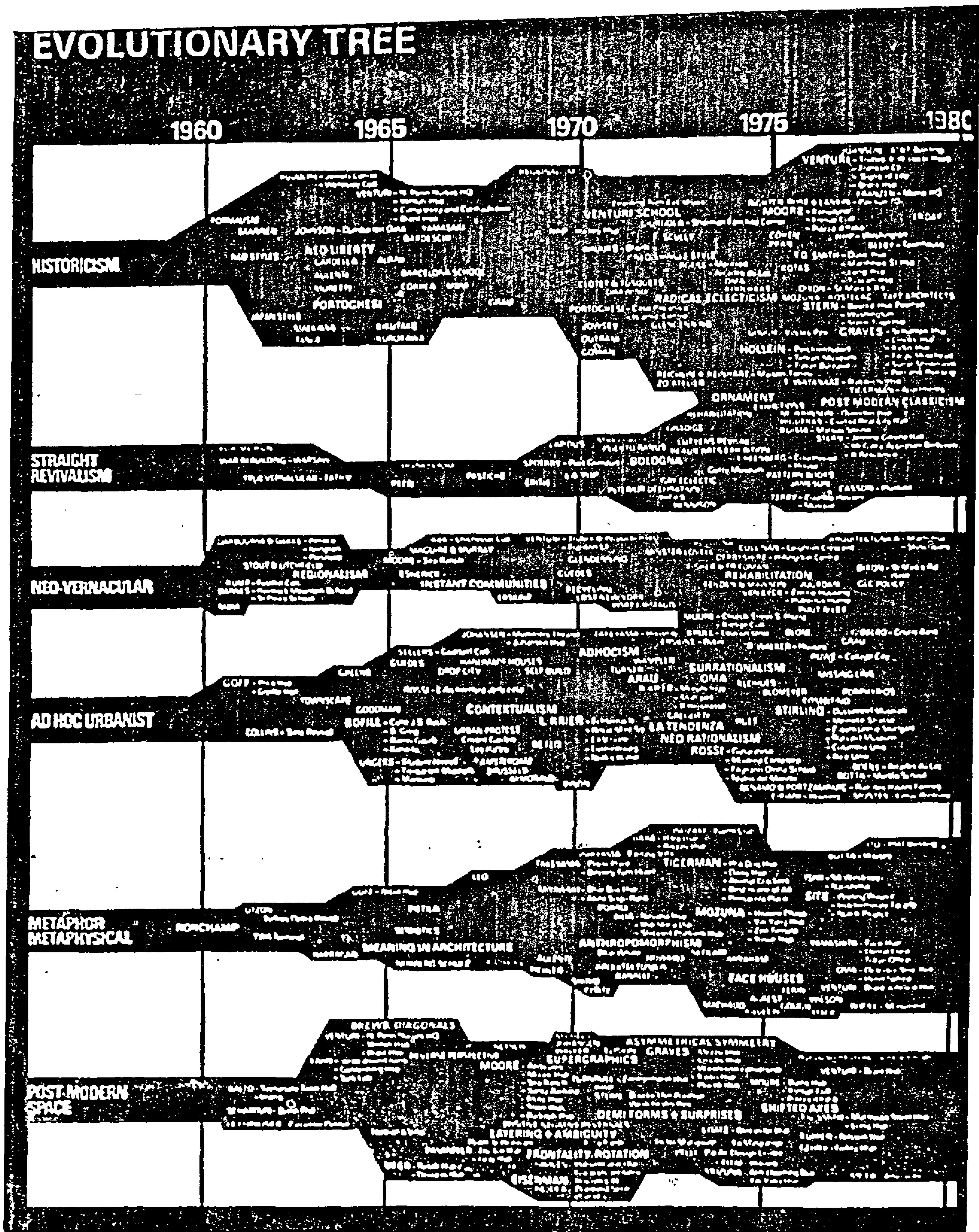
٢ – أن الحركة المعمارية المعاصرة تأسست بدعوة من المهندس المعمارى لوكور بوزييه «Le Corbusier» والمؤتمر العالمى للعمارة المعاصرة من (١٩٢٨ – ١٩٥٦ م) C.I.A.M. - «Congress International d'Architecture Modern» . وهذه المعاصرة تمثل « صحوة للحركة المعمارية لاقت استجابة واسعة فى جميع أنحاء العالم وعرفت باسم العمارة المعاصرة (٨) .

ولعل التحليلين المرفقين (شكل ٣ ، شكل ٤) والموضوعين من قبل الكاتب المعمارى جنكز (٩) (١٠) «C. Jencks». يقدمان .



(شكل رقم ٣)

تحليل لتاريخ نشأة الحركات المعمارية المختلفة منذ بداية القرن العشرين ، ويوضح صعوبة رسم خطوط فاصلة واضحة بين هذه الحركات .



(شكل ٤) تسلسل الحركات المعمارية المتعاقبة منذ الخمسينات والتى يصعب معها تحديد زمن حقيقى لظهور هذه الحركات (١٠).

الدليل الواضح على مدى الارتباط والتداخل بين الحركات المعمارية المعاصرة ، وصعوبة تحديد زمن حقيقى لظهور الحركات المعاصرة فى العمارة .

٣ ــ أن « العمارة المعاصرة » تتميز بالبساطة والعقلانية فى الجمع بين الوظيفية والخصائص الجمالية . وقد وصف بانهام (١١) «R. Banham» العمارة المعاصرة بانها تمتاز بأن لديها الكثير مما تقترحه بأساليب متعددة وأنها قد أبرزت المعالم القديمة بطريقة صريحة ، لأنها تركت بعض المرئيات القديمة مثل الزخرفة الطبيعية لكى تتفرغ للتركيز على مقومات أهم» .

٤ ـ انها تحمل سمة المعاصرة فى استخدام المواد وطرق التطبيق والتقنيات والانشاء من اجل ان تتلائم مع الأهداف التى شيد من اجلها البناء فقد وجدت نظم انشاء متطورة لم تكن مطبقة فى أى من العصور السابقة ، ولم تستعمل الا فى « العمارة المعاصرة » وهذه العمارة تمثل تجديدا فى مبدأ التشكيل والتكوينات الفراغية «New forms to the new architectural concepts of space».

٥ ـ انها اعتمدت الصراحة فى شكل الفراغ ومضمونه وهى سمة أصبحت من المميزات الأساسية للطراز العالى باستثناء الحركة التعبيرية فى العمارة وانماط التشكيل المعمارى على النطاق القومى .

٦ ـ انها تأثرت بتطورات الفنون الجديدة فى الرسوم التشكيلية الحديثة والنحت ونشر المعلومات العالمية عن المشاريع المعمارية والأعمال التى يتم انجازها والتعريف بالنشاط المعمارى والانشاء حول العالم ، مقارنة مع ما سبقه فى تاريخ المعمار الانسانى .

٧ ـ انها افرزت المبانى التى طبق فى تصميمها مبدأ حيوية المعرفة بنظم الانشاء وتوضيح التناسق بين عناصر المبنى المختلفة ، كما هى الحال بين الانسان والقياس الانسانى «Human Scale» والتقنيات المعاصرة والمتاحة من خلال العلوم والصناعة والادارة التى قدمت بمجموعها الشيء الكثير للعمارة المعاصرة .

٨ ـ انها تمثل عهدا من الشعور بالثقة فى بساطة الحلول الشاملة للمشكلة الاجتماعية والانسانية وهى الثقة بالأنظمة «a faith in systems» ـ وهى ايضا تمثل اعتقادا بين المعماريين يعرف بالاستقلال الاستبدادى «dictatorial autonomy» فلقد ذكر جنكز (١٠) «C. Jencks» ـ بانه قد اصبح الاستبداد مبدءا دكتاتوريا واحدا «totalitarian» من افضل ما يمكن أن توصف به العمارة المعاصرة ، وصار هذا الوصف سمة تاريخية لها .

فقد كتب بوين (٣) «C. Boyne» ـ ما مؤداه ان المميز الأساسى للعمارة المعاصرة هو الحرص على توفير بيئة فضلى يستمتع فيها بالتقدم الاجتماعى والأزدهار الاقتصادى .

ووصفها ولسون (١٢) "C. Willson" ـ على لسان الفر آلتو "Alvar Aalto" بأنها كالثورة التى تبدأ بحماس ثم تنتهى بنمط من انماط الدكتاتورية .

٩ ـ انها اتخذت من البرنامج مصدرا تنظيميا للوحدة والانسجام "Unity and Harmony" يؤدى الى تطوير الفكر المعمارى ومفهوم التصميم «Understanding of design» فى تنظيم البيئة وتلبية احتياجات المستوطنات البشرية .

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« المعايير والمعدلات التخطيطية لمشروعات اسكان النقابات »

دكتور / يحيى عثمان شديد

المشكلة واهمية دراستها الآن :

من الواضح ، وبالرغم من الجهود التى قامت بها الدولة فى مواجهة الطلب للفئات محدودة الدخل ، والتى شملت وضع الخطط والبرامج العاجلة منذ ظهور القطاع العام الاسكانى فى الخمسينات وحتى الآن ، الا أنه قد اتضح تماما قصور الدولة فى توفير وحدات سكنية مدعمة لمقابلة الطلب المتزايد لفئات عريضة من مجموعات الدخل المنخفض،فى الوقت الذى استطاع فيه « القطاع الخاص » بشقيه الرخص / غير المنظم المساهمة الفعالة فى هذا المجال .

وبالنظر فى السياسات الاسكانية التى تتبعها الحكومة الآن فى ظل تنفيذ الخطة القومية الثانية للتنمية الاقتصادية والاجتماعية (٨٧ — ١٩٩٢) ، نجد انه جارى بناء ٦٠٠ الف وحدة سكنية بمعدل تشييد يبلغ ١٢٠ الف وحدة / سنويا من المساكن منخفضة التكاليف (غير تامة البناء) التى لا يزيد اسعارها عن ٦ و ٨ و ١٢ الف جنيه للوحدة بمسطحات تبدأ من ٤٥ مترا حتى ٩٠ مترا (١) . وهذا الكم من وحدات الاسكان — مع فرض انجازه — لن يساهم فى توفير السكن الصحى الملائم للفئات العريضة من محدودى الدخل مع توافر المنافع والخدمات العامة لهم داخل مستقرات انسانية متكاملة . بل سيكون أهدارا للمال العام ، والبيئة العمرانية ككل .

وخير شاهد على هذا ، « مشروعات الاسكان العام » الحالية التى غالبا ما تقام على اراضى داخل المدن أو على اطرافها وفى مواقع غير مناسبة سواء للاستعمالات المجاورة أو بالنسبة لصالحية التربة ، كما أن النماذج السكنية المستخدمة محدودة للغاية (١ — ٣ نموذج) ذات مساحات صغيرة جدا فى أغلب الاحوال ، وهى فى مجملها لا تتلائم مع طبيعة وعادات السكان المتنوعة ، وكذلك الحال فى تخطيط مواقع الخدمات العامة ، مع استخدام معايير ومعدلات تخطيطية كبيرة غير ضرورية بالنسبة للمسارات والأرض الفضاء غير المحددة مع ضعف امكانيات المحافظة للاشراف وصيانة تشغيل المرافق فى هذه المشروعات ، ولهذا تصبح مع مرور الزمن أحياء متخلفة .

ومن جهة أخرى ، ففى اغلب الاحوال ، لن تتمكن فئات الطلب « الحقيقى » من ذوى الدخل المحدود من شراء وحدات الاسكان منخفض التكاليف خلال الخطة الحالية — السابق الاشارة اليها — التى تقوم الدولة ببنائها ودعمها ماليا (التمليك) نظرا للزيادات الهائلة المستمرة فى عناصر التكاليف فى مشروعات الاسكان العام (نتيجة التضخم ، والذى يقدر معدل نموه السنوى بنسبة تتراوح ما بين ١٨ — ٣٥ ٪ ، على اقل تقدير) ، لذلك فهو اسكان « مؤجل التمليك » وليس منخفض التكاليف — كما يطلق عليه . وعليه فإن فئات عريضة ممن لا يجدون المسكن ، او قد يجدونه ولكن فى مستوى غير انسانى أو بتكلفه تنوء بها قدرتهم المحدوده،ومنهم شباب الخريجيين من الجامعات والمعاهد العلمية من أعضاء النقابات المهنية جنبا الى جنب مع طبقات وشرائح اجتماعية أخرى ، مثل : العمال الحرفيين ، العمال الحكوميين ، الباعة الجائلين ، او ذوى العمل غير المنظم ،وحتى هؤلاء الذين لا عمل لهم (٢) . سوف تتجه نحو سكن القبور والعشش والمساكن الجوازية التى تقام أسفل السلالم وفوق الاسطح والتى لا تتوافر فيها الشروط الصحية كدورات المياة والهواء الصحى وأيضا مساكن « الشرك » (والتى فيها تسكن اكثر من عائلة معا فى وحدة واحدة) . وفى أحسن الاحوال ، سوف تتجه بعض هذه الفئات الى هوامش المدن القائمة لاستيطان افضل الاراضى الزراعية طلبا للمسكن المتاح ، وتدل الدراسات على أن مصر سوف تفقد خلال السنوات القليلة القادمة وحتى عام ٢٠٠٠ حوالى ١/٢ رقعتها الزراعية المحدودة نتيجة لنمو التجمعات السكانية عليها .

هدف البحث :

ومن بحثنا فى السياسات الاسكانية السابق ذكرها وحجم « الطلب المتوقع » على الاسكان

الحضرى فى المستقبل القريب ، يظهر بوضوح اهمية وموضوعية خاصة لبحث وتناول تحديد المعايير والمعدلات التخطيطية الموجه لتصميم الحلول للمجموعات والوحدات السكنية لفئات محدودى الدخل .

ان الحجم المتزايد للانشاء العمرانى الجديد الحالى والمستقبلى الموجه لخدمة الفئات العريضة من سكان المجتمع فى المدن والمناطق الهامشية ، كذلك مشاكل خدماتهم وتنوع وكثرة عناصرها كل هذه العوامل تتطلب ايجاد الأساس العلمى لمعايير ومعدلات الاسكان كقاعدة أساسية تسبه عملية البدء فى تصميم وتشييد المستقرات الانسانية ، وهذا مما يؤكد اهمية وضرورة البحث الآن . ان عملية استخلاص معدلات ومعايير من الفكر الفلسفى التخطيطى والمعمارى الذى صاحب وضع الحلول الملائمة للسكان ، يهدف الى وضع معايير ومعدلات اسكان خاصة لمصر ، وهذه المشكلة لم تحل حتى الآن ، وهى دائما ذات موضوعية ملحة ولازمة للبحث العلمى — وهذا ما سوف يتناوله هذا البحث .

منهج البحث :

يعتبر التوظيف الفعال للارض الحضرية « الاساس فى توفير الخدمات والانشطة المختلفة داخل بيئة الاسكان الحضرية ، وهذا يعنى تحديد معدلات استعمالات الاراضى لكل من : السكن — الخدمات الاجتماعية — الحدائق والمناطق المفتوحة والترفيهية — المسارات (الحركة أو السير) داخل كتلة الاسكان ، وذلك فى ضوء معيارين أساسيين لفاعلية استخدام الارض ، وهما :

— معيارا لكثافة الحضرية ،

— ومعيار الاستهلاك لكل فرد من الارض للاستخدامات العمرانية المختلفة .

وكل من هذين المعيارين ، يؤثر بصورة مباشرة على « حلول الاسكان فى المناطق الحضرية » . وهذا ما سوف نتبينه من تحديد معدلات كل مجموعة من مشروعات الاسكان التى شملت على كافة النماذج السكنية التى يجرى البناء على منوالها حاليا فى حضر مصر ، وهى على النحو التالى :

— المجموعة الاولى :

مشروعات الاسكان العام ، التى نفذت طوال الفترة الماضية فى مدينة القاهرة ، وتعتبر نماذج وصورا لما كان يقام فى باقى مدن مصر التى أقيمت فيها مشروعات اسكان منذ الستينات حتى منتصف السبعينات وتتمثل هذه المشروعات فى مناطق اسكان : عين الصيرة (٣) ، بحرى حلوان (٤) وتخدم على التوالى ٣٠ ، ٤٥ الف نسمة .

— المجموعة الثانية :

مشروعات التوسع العمرانى ، على اطارف المدن وتتمثل فى مشروعات اسكان البركة (مدينة السلام) شمال مدينة القاهرة والذى بدا فى تنفيذه فى اواخر السبعينات ليخدم ٢٥٠ الف نسمة (٥) .

— المجموعة الثالثة :

مشروعات التعمير فى مدن القناة ، ويمثلها : اسكان « كابنون » بالسويس (٦) « وابو عطوه » و « الحكر » بالاسماعيلية (٧) وتخدم على التوالى ٦ر٤٠ ، ٤٤ ، ٩٠ الف نسمة .

— المجموعة الرابعة (٨) :

مدن توابع ، مثل ٦ أكتوبر ، ١٥ مايو ، حلوان الجديدة وتستوعب على التوالى ٣٥٠ ، ١٥٠ ، ١١٠ الف نسمة .

— المجموعة الخامسة (٩) :

المدن المستقلة الجديدة ، وتستوعب حوالى ٥٠٠ ألف نسمة ، وهى : ١٠ رمضان ، السادات ، العامرية .

— المجموعة السادسة (١٠) :

مدن قائمة ، مثل مدينة نصر شاملة كافة مناطقها السكنية (١ — ٩) وتخدم حوالى ٢٠٠ الف نسمة .

ويلاحظ أن المجموعات الثلاث الاولى ، تهدف لخدمة مجموعات الدخل المنخفض / متنامى وكذلك مدينة حلوان الجديدة فى المجموعة الرابعة ، بينما بقية المشروعات الموضحة بالمجموعتين الرابعة — السادسة تضم كافة المستويات السكنية من الاقتصادى حتى الفاخر .

ومن خلال التحليل القارن لمشروعات الاسكان الموضحة اعلاه (المجموعات ١ — ٦) ، يمكن استخلاص المعدلات الملائمة لكل من الكثافات الكلية / الصافية ، استعمالات الاراضى ، ونصيب الفرد من الاستخدامات الحضرية . واضعين فى الاعتبار اختيار المعدلات مستويين ...

الاول : مدن قائمة / جديدة .
والثانى : توسعات عمرانية / مشروعات التعمير .

ثم يتناول البحث ، تحليل تدرج التجمعات السكنية بالمجتمعات العمرانية وما يخصها من الخدمات العامة ونصيب الفرد فيها من المستويات السكنية : قطاع ، مناطق ، أحياء ، وحدات تخطيطية . ويركز البحث ، بصفة خاصة على معدلات الخدمات العامة على مستوى الوحدة التخطيطية (المجاورة السكنية) .

وبعد ذلك ، أمكن اقتراح المعدلات الطبيعية اللائمة للوحدة التخطيطية لمشروعات الاسكان لذوى الدخل المحدود / المتوسط ، والتى يمكن لها أن تنمو وتتطور طبقا لاحتياجات السكان .

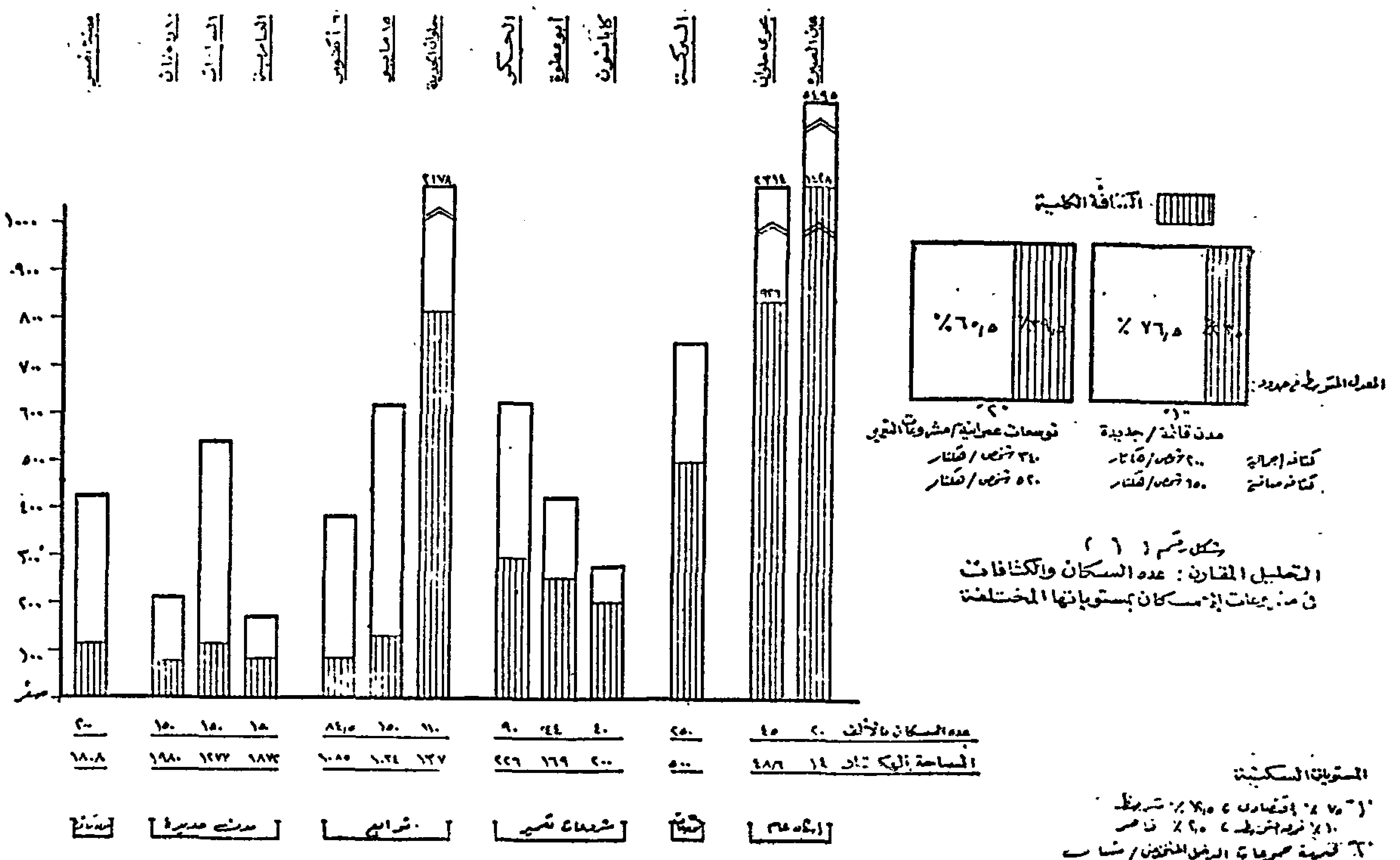
وأخيرا ، ومن خلال دراسة المعايير التخطيطية والنماذج السكنية القائمة بتجمعات الاسكان الخاص ـ وفى ضوء المقومات الاقتصادية / الاجتماعية لفئات الدخل المحدود من المهنيين أعضاء النقابات ـ ثم وضع اقتراح « وحدة تخطيطية » تصلح لأن تكون « نموذجا » لمشروعات اسكان النقابات يمكن أن يتبع فى المستقبل .

اولا ـ الكثافات السكانية :

يشير الشكل رقم (١) الى **« عدد السكان والمساحة والكثافات السكانية الكلية والصافية »** بمشروعات الاسكان بالمجموعات (١ ـ ٦) الموضحة عالية ، ومن التحليل المقارن لهذه المشروعات اتضح أن :

١ ـ أعلى معدل للكثافات السكانية يوجد فى المجموعة الاولى (الاسكان العام داخل المدن) بمشروعى « عين الصيرة » و « بحرى حلوان » ويصل معدل الكثافة فى كل منها الى ١٤٢٨ ـ ٩٢٦ شخص / هكتار على التوالى ، ويلاحظ أن الكثافة الصافية ، على المناطق السكنية فى هذه النوعية من المشروعات ، تصل الى معدلات غير انسانية (٥٤٩٥ شخص / هكتار) ، مسببا تدهورا تاما فى البيئة العمرانية .

٢ ـ مخططات الاسكان العام فى كل من : التوسعات العمرانية (مجموعة ٢) ، ومشروعات التعمير (مجموعة ٣) والتى تهدف لتوفير الوحدات لفئات الدخل المحدود (وان اختلفت سياسات الاسكان فى كل منها ، وكما سيأتى ذكره) ، يتراوح معدل الكثافة فى تلك المشروعات ما بين ٢٠٣ ـ ٥٠٠ شخص / هكتار على التوالى فى كابنون ـ البركة كما يتراوح معدل الكثافة الصافية فى ذات المشروعين ما بين ٢٩٠ ـ ٧٥٠ شخص / هكتار .



شكل رقم (٦)
التحليل المقارن : عدد السكان والكثافات فى مشروعات الاسكان بمستوياتها المختلفة

٣ ـ المجتمعات العمرانية الجديدة ـ التى تهدف الى خدمة مجموعات الدخل المنخفض ، مثل : مجتمع حلوان الجديد (المجموعة ٤) ، قد خططت لاستيعاب كثافات اكبر من مشروعات الاسكان الاخرى فى المدن والمجتمعات الاخرى ، اذ يصل معدلى الكثافة الكلية والصافية لحلوان الجديدة على التوالى الى : ٨٠٣ ، ٢١٧٨ شخص / هكتار وذلك خلال المرحلة النهائية لنمو المدينة (١١٠ الف نسمة) . وبالرغم من أن هذا المعدل العالى ، يرجع الى حد ما الى النقص فى استعمالات الاراضى الصناعية ، فانه ينسب أساسا للانخفاض فى المساحات المخصصة لكل من : الخدمات ـ الفراغات المفتوحة ـ المسارات (وكما سيأتى ذكره ـ انظر شكل ٣) . ويلاحظ خلال المرحلة الاولى لنمو المدينة (٣٠ الف نسمة) ان المعدلين السابق الاشارة اليهما ينخفضان الى ٢١٩ شخص / هكتار كثافة كلية ، و ٥٩٤ شخص / هكتار كثافة صافية وذلك خلال المرحلة الجارى تنفيذها الآن .

٤ ـ تشير الكثافات السكانية لبقية المدن (المجموعات ١ ـ ٦) الى كثافات منخفضة للغاية تصل الى ادناها فى كل من ٦ اكتوبر ، العامرية ، العاشر من رمضان ، حيث تصل على التوالى الى ٧٨ ، ٨٠ ، ٧٦ شخص / هكتار ثم ترتفع الى ١١١ شخص / هكتار فى مدينة نصر ، أما الكثافة الصافية فتبلغ اقصاها خلال المرحلة النهائية لنمو مدينة ١٥ مايو (١٥٠ الف نسمة) ، حيث يصل المعدل الى : ٦١٣ شخص/ هكتار ـ وهذا المعدل نم عن فائدة عظيمة بالانتفاع بأرض المناطق السكنية بالمدينة .

نتيجة ١ :

بناءا على ما سبق دراسته ، يمكن تحديد واقتراح « معدل متوسط للكثافات بمشروعات الاسكان على مستويين (وكما هو موضح بالشكل ١) :

المستوى الاول

مدن قائمة / جديدة

كثافة كلية	٢٠٠ شخص / هكتار
كثافة صافية	٦٥٠ شخص / هكتار

المستوى الثانى

توسعات عمرانية / مشروعات تعمير

كثافة كلية	٣٤٠ شخص / هكتار
كثافة صافية	٥٢٠ شخص / هكتار

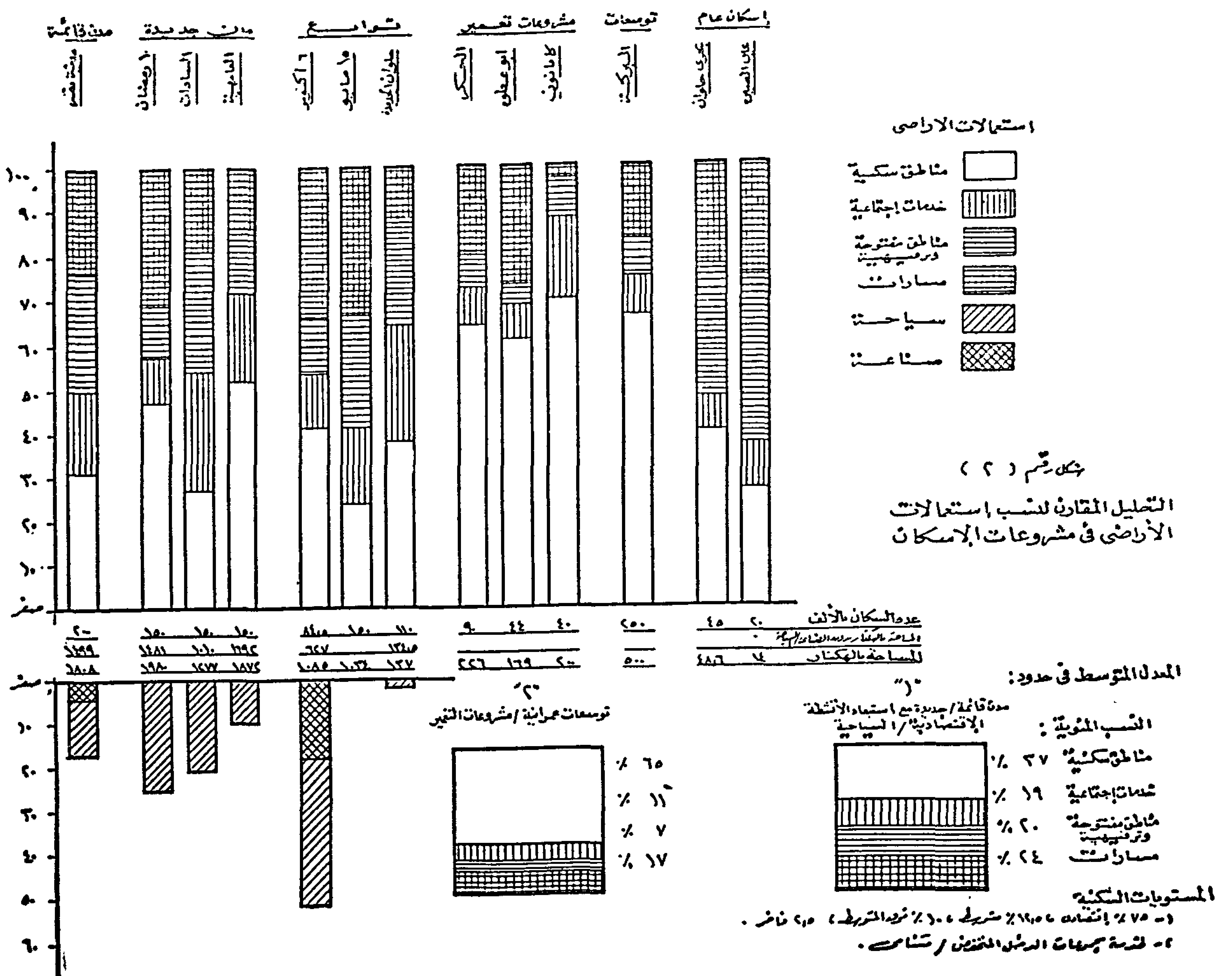
ثانيا : استعمالات الاراضى :

يبين الشكل رقم (٢) ، التحليل المقارن « لنسب استعمالات الاراضى » ـ فى مشروعات الاسكان بالمجموعات (١ ـ ٦) السابق بيانها ـ وقد تم وزيع هذه النسب على اساس الفصل بين الانشطة العمرانية الاساسية (مناطق سكنية ، خدمات اجتماعية ، مناطق مفتوحة / ترفيهية ، مسارات) ، وبين الانشطة الاقتصادية (سياحى / صناعى) وذلك بغية الوصول الى معدلات اقرب ما تكون الى الواقع . وبناءا عليه ، فقد اتضح الآتى :

١ ـ مشروعات الاسكان العام داخل المدن (المجموعة ١) ، تظهر اهدارا ضخم لارض الحضر ، فمناطق الاسكان فيها محدودة للغاية بالنسبة لمساحة الموقع (٢٦٪ فى عين الصيرة) ، بينما هناك مساحات بنسب ضخمة تتعدى نصف مساحة المشروع (٦٤٪ فى عين الصيرة) وهذه النسبة تخصص للمناطق المفتوحة والمسارات ، وبالطبع هذه المسطحات الضخمة تتحول تدريجيا الى مقالب للقمامة وتوالد الامراض والاوبئة وتخلق مجالا واسعا لاستيلاء الاهالى عليها بكافة الاساليب وطرق التعديات .

٢ ـ تخصيص الارض « للاستعمالات السكنية » ، يصل الى اقصاه فى مشروعات التوسعات والتعمير (المجموعة ٢ ـ ٣) ، فمثلا الاستعمالات السكنية فى كابنون السويس تصل نسبتها الى ٧٠ ٪ من اجمالى استعمال الارض، ويمكن تعليل السبب فى ذلك أن سياسات الاسكان فى مثل هذه المشروعات ، تقوم على اساس تقسيم الاراضى وتنظيمها بهدف توفير « مساكن اساس » او (مساكن نواه) يتراوح مساحة كل مسكن فيها ما بين ٢٠ ـ ٢٨ مترا مربعا ، وتقام هذه المساكن على قطع أراضى تتراوح مساحتها ما بين ٩٠ ـ ١٨٠ مترا مربعا . مع الحد من الاراضى المخصصة للاستعمالات الاخرى ، فمثلا ما يخصص من الارض للمناطق المفتوحة يبلغ نسبة ٩٪ من اجمالى مساحة المشروع .

٣ ـ « المناطق المفتوحة » و « المسارات » فى المجتمعات العمرانية الجديدة / القائمة (المجموعات : ٤ ـ ٦) ، يخصص لهما استعمالات اراضى بنسبا لا يستهان بها ، فمثلا ، الارض المخصصة للمناطق المفتوحة تصل الى نسبة تتراوح ما بين ٢٤ ـ ٢٧٪ فى : حلوان ـ ١٥ مايو ـ السادات ـ مدينة نصر . وكذلك الحال بالنسبة للارض المخصصة للمسارات التى تصل الى نسبة ٣١ ـ ٣٥٪ من اجمالى الاستعمالات فى كل من ١٠ رمضان ـ ١٥ مايو ـ ٦ اكتوبر .



شكل رقم (٢)
التحليل المقارن لنسب استعمالات الأراضى فى مشروعات الإسكان

٤ ــ أما « الخدمات العامة » ، فاكبر تخصيص اراضى لها ، نجده فى مدينتى السادات وحلوان الجديدة ، وتبلغ على التوالى نسبة ٢٦ ــ ٢٦٫٩٪ من اجمالى مسطح المدينتين ، وتنخفض هذه النسب الى ادناها لتبلغ ١٠٫٣٪ من مساحات المرحلة الاولى لمدينة العاشر من رمضان (١٥٠ الف نسمة) .

نتيجة ٢ :

بناء عما سبق ، يمكن تحديد معدل متوسط لنسب استعمالات الأراضى فى حدود الآتى (وكما هو موضح بالشكل ٢) :

المستوى الأول

مدن قائمة / جديدة

مناطق سكنية	٣٧٪
خدمات اجتماعية	١٩٪
مناطق ترفيهية ومفتوحة	٢٠٪
مسارات	٢٤٪

المستوى الثانى

توسعات عمرانية / مشروعات تعمير

مناطق سكنية	٦٥٪
خدمات اجتماعية	١١٪
مناطق ترفيهية ومفتوحة	٧ ٪
مسارات	١٧٪

ثالثا : نصيب الفرد من الاستخدامات الحضرية :

يوضح الشكل رقم (٣) نصيب « الفرد من كافة الاستخدامات » فى مشروعات الاسكان السابق بيانها ، ومن التحليل المقارن لتلك المشروعات ، يمكن استخلاص الحقائق التالية :

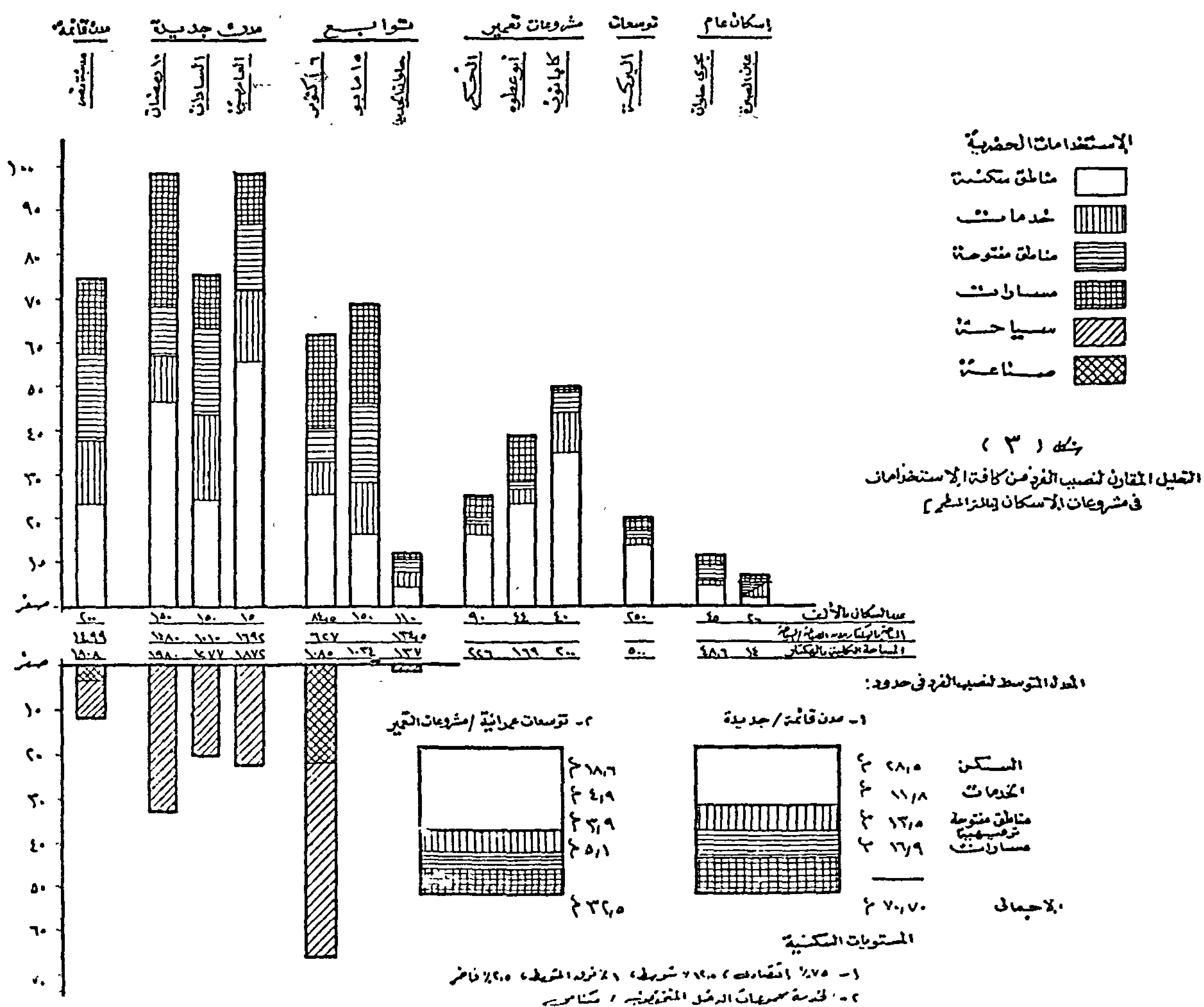
١ ــ معدل استخدام الفرد من الارض الحضرية يتفاوت تفاوتا كبيرا بين تلك المشروعات ، ليس فقط على مستوى المجموعات ككل (من ١ الى ٦) ، ولكن على مستوى المجموعة الواحدة ، وايضا على مستوى الدخل المتجانسة . فمثلا ، مشروع اسكان البركة بالتوسعات العمرانية (مجموعة ٢) شمال القاهرة ، الذى يستوعب ٢٥٠ الف نسمة حتى عام ٢٠٠٠ ، يقوم على أساس أن يستعمل « كل فرد » من السكان ذوى الدخل المحدود ٢٠م٢ لكل يقوم بكل الانشطة الحضرية بالمشروع ، بينما نجد هذا المعدل ينخفض بشكل ملحوظ فى مشروعات الاسكان العام داخل الكتلة الحضرية (المجموعة ١) فيصل الى ٩٫٩٤ ــ ٧٫٠م٢ على التوالى فى مشروعى « بحرى حلوان » و « عين الصيرة » . بينما نجد أن هذا المعدل يرتفع فى مشروعات التعمير (المجموعة ٣) فى الاسماعيلية

الى ١ر٢٥م٢ — ٣ر٣٨م٢ لكل فرد على التوالى فى مشروعى اسكان « الحر » و « أبو عطوه » ، ثم يرتفع هذا المعدل ليصل الى ٣ر٤٩م٢ لكل فرد فى « كابنون » بالسويس ، ويلاحظ أن هذا الرقم يشكل أعلى نصيب للفرد من فئات الدخل المحدود للاستخدامات الحضرية وموزع كالآتى : ٥ر٣٤ — ٩ر٨ — ٤ر٤ — ٥ر١م٢ لكل فرد على التوالى من استخدامات : السكن — الخدمات — المناطق المفتوحة — المسارات ، أما أقل المعدلات فنجده فى « عين الصيرة » : ٨٢ر١م٢ للسكن — ٧٦ر٤م٢ للخدمات والمناطق المفتوحة — ٨٢ر١م٢ للمسارات .

٢ — أقصى معدل سابق بيانه لنصيب الفرد من الاستخدامات الحضرية ، يتضاعف فى المدن الجديدة (مع استبعاد الاستعمالات الصناعية / السياحية) ، ليصل الى : ٧ر٩٨ — ٨ر١٠٢م٢ لكل فرد على التوالى فى مدينتى العاشر من رمضان والعامرية وذلك خلال المرحلة الأولى لنمو المدينتين (١٥٠ الف نسمة) .

٣ — يتساوى (تقريبا) معدل نصيب الفرد من الأرض لكى يقوم بكل الأنشطة الحضرية فى كل من : ١٥ مايو ، السادات ، ومدينة نصر . فيصل هذا المعدل فى كل منها على التوالى الى : ٩ر٦٨ ، ٦ر٧٦ ، ٧٥م٢ .

٤ — من المدهش ، أن ينخفض هذا المعدل الى ادناه فى مجتمع حلوان الجديد فيصل الى ٣ر١٢م٢ ، ويمكن تعليل السبب الأساسى فى هذا المعدل المنخفض الى انه مخطط خلال المرحلة الأولى لنمو المدينة أن تستوعب ٣٠ الف نسمة على مساحة ١٣٧ هكتار ، وقد خططت فى هذه المرحلة ٦٢٧١ قطعة أرض تزود بالحد الأدنى من نواة المسكن (أو مسكن الأساس) ، الذى يبلغ مسطح المسكن فيه ٢٠ مترا مربعا ، ومن بيع حصيلة تلك القطع يمكن تغطية تكاليف المجتمع السكنى ككل ، للوصول الى اسكان ١١٠ الف نسمة فى المرحلة النهائية لنمو المجتمع، لذلك فمعظم السكان (٨٠ الف نسمة) سوف يقيمون فى « وحدات ايجارية » ، يتم تشييدها من خلال



شكل (٣)
التحليل المقارن لنصيب الفرد من كافة الاستخدامات فى مشروعات الاسكان [بالمتر المربع]

التمويل الذاتي للمشروع ، اى من حصيلة ما يدفعه المشترين الأوائل من مواردهم الخاصة لقطع الأراضي المجهزة والسابق ذكرها ، وسكان الواحدات الايجارية سيقيمون على ذات المساحة المخصصة للمدينة (١٣٧ هكتار) ، وهذا مما يؤدى بدوره الى خفض نصيب الفرد من كل الأرض الحضرية ليبلغ : ٦ر٤٢م٢ للسكن — ٢ر٣م٢ للخدمات — ٣م٢ للمناطق المفتوحة — ٥ر١م٢ للمسارات .

٥ — المعدلات السابقة فى مجموعها تقل عما يتم تخصيصة للخدمات فقط فى مدينتى العامرية والسادات ، اذ يبلغ على التوالى ٢ر١٦—٨ر١٩م٢ خلال المرحلة الأولى لنمو المدينتى (١٥٠ الف نسمة) .

٦ — متوسط متطلبات السكن بالنسبة للفرد فى المجتمعات العمرانية الجديدة يتفاوت تفاوتا كبيرا ، فالبرغم من ان الحصة الكبرى من وحدات الاسكان فى كل من مدينتى : « ١٠ رمضان » و « ١٥ مايو » عبارة عن بلوكات سكنية ترتفع لخمسة طوابق ، فان متطلبات الأرض السكنية للفرد فى المدينة الأولى (٣ر٤٦م٢) هو ما يعادل ثلاث مرات نفس الأرض المطلوبة فى الثانية (٣ر١٦م٢) .

٧ — بمقارنة ما سبق ذكره بمشروعات اسكان محدودى الدخل (التى تهدف الى الاقلال من تكلفة تنمية مناطق الاسكان عن طريق بيع قطع الأراضى) . يلاحظ ان ، تلك المشروعات تخصص مساحات بمعدل يتراوح ما بين ١ر١٦—٢٣م٢ على على التوالى ، بمشروعى الحكر وابو عطوة بالاسماعيلية .

نتيجة ٣ :

بناء لما سبق ، يمكن تحديد واقتراح « المعدل متوسط » لنصيب الفرد بمشروعات الاسكان (طبقا لحدود الموضحة بالشكل رقم ٣) وهى كالآتى :

المستوى الأول

مدن قائمة / جديدة

السكن	٥ر٢٨م٢
الخدمات	٨ر١١م٢
مناطق مفتوحة / ترفيهية	٥ر١٣م٢
مسارات	٩ر١٦م٢

المستوى الثانى

توسعات عمرانية / مشروعات التعمير

السكن	٦ر١٨م٢
الخدمات	٩ر٤ م٢
مناطق مفتوحة / ترفيهية	٩ر٣ م٢
مسارات	١ر٥ م٢

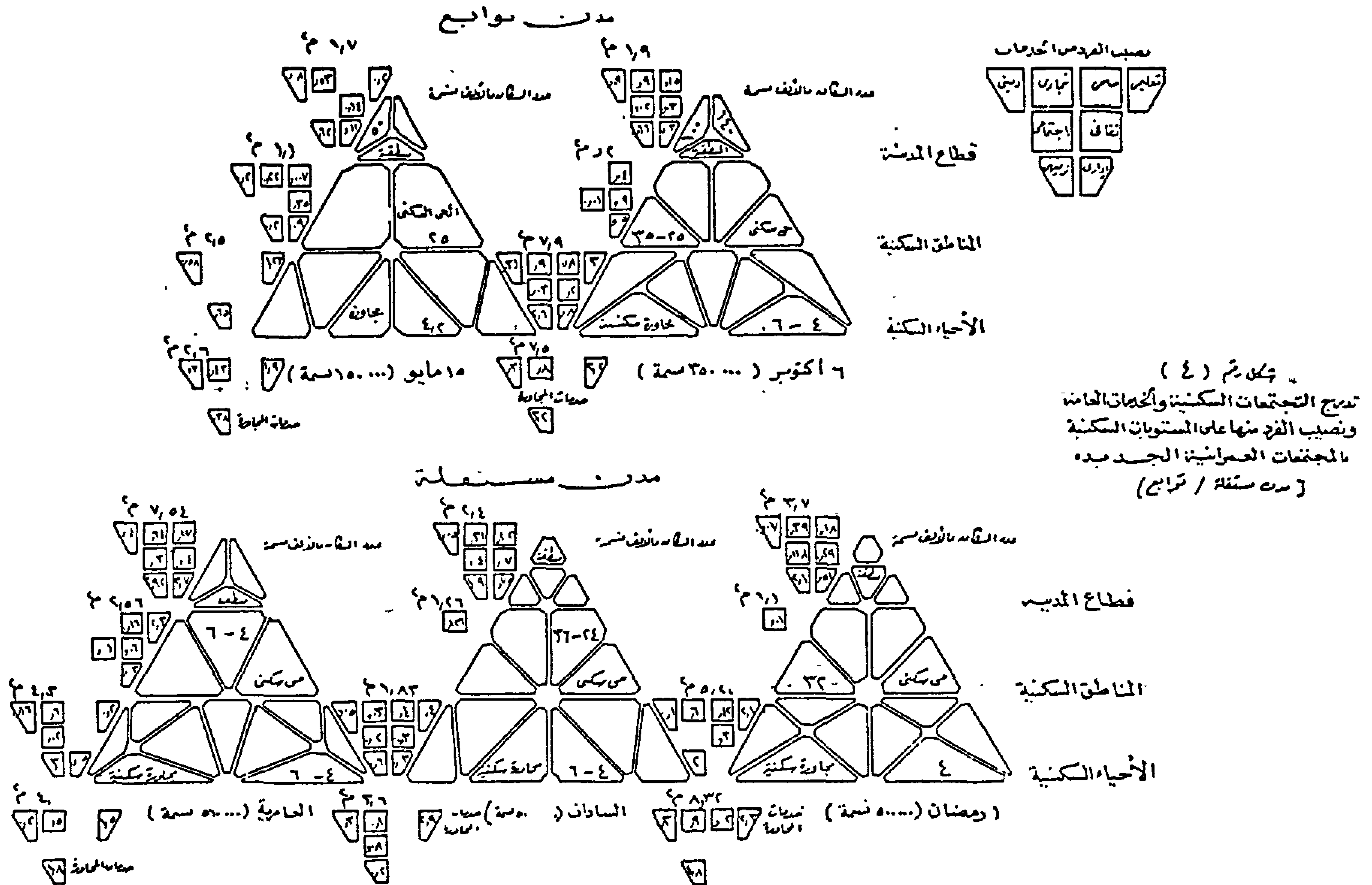
رابعا — التشكيل الهرمى لتوزيع السكان والخدمات العامة :

يشير الشكل رقم (٤) الى « **تدرج التجمعات السكنية والخدمات العامة ونصيب الفرد** » منها على المستويات السكنية بالتجمعات العمرانية الجديدة (المجموعتان ٤ ، ٥) وهى نماذج لما يجرى تنفيذه حاليا فى مصر . والغرض من اعداد هذا الشكل هو الوصول الى معايير ومعدلات تخطيطية مثلى لتوزيع السكان داخل هياكل تخطيطية ، واضحة المعالم ، يضمها اطارا من التسلسل الوظيفى لمكونات المستقرات الانسانية على المستويات المختلفة ، من الوحدات التخطيطية (النواة) حتى المدينة ، مع ما يلزم من توفير عناصر الخدمات العامة بصورة متكاملة ، من خلال « تشكيل هرمى » يهدف الى تحقيق حياة رغده ومحيط معيشى مناسب للسكان ، ويؤدى فى نفس الوقت وظيفة حماية الروابط الاجتماعية وتدعيم العلاقات الدينية وتوفير الرعاية الصحية والثقافية داخل المجتمعات الانسانية .

والمجتمعات العمرانية الجديدة تنقسم الى : « مدن مستقلة » مكتفية ذاتيا ، والخرى « مدن تابعة » لها صلة وثيقة بالمدينة الأم (العاصمة) وتعتمد عليها فى مؤسساتها الاقتصادية والثقافية والاجتماعية .

وتشمل المدن الجديدة (المستقلة) كل من : العاشر من رمضان ، السادات ، والعامرية الجديدة ، اما المدن التابعة والممثلة فى شكل (٤) ، فهى : ١٥ مايو ، و٦ اكتوبر وعدد سكانها المقدر يبلغ على التوالى ١٥٠ — ٣٥٠ الف نسمة .

ويظهر قطاع الخدمات العامة — فى تلك المدن المشار اليها — فى صورة مراكز مختلفة الحجم والوظائف تبعا للتدرج الهرمى لتوزيع السكان على المدينة وتخطيطها العام ، ومن هنا تظهر المراكز ذات المستويات المختلفة ...



شكل رقم (٤)
تدرج التجمعات السكنية والخدمات العامة ونصيب الفرد منها على المستويات السكنية بالمجتمعات العمرانية الجديدة
[مدن مستقلة / توابع]

وذلك على النحو الآتى :

١ ــ قطاع المدينة :

تهدف المخططات العامة للمجتمعات العمرانية الجديدة أن تستوعب حتى عام ٢٠٠٠ عدد من السكان يبلغ فى مدن « التوابع » : ١٥ مايو و ٦ أكتوبر ، على التوالى ، ما بين ١٥٠ ــ ٣٥٠ ألف نسمة . أما فى المدن المستقلة فمخطط لها أن تستوعب حوالى ٥٠٠ ألف نسمة مع نهاية هذا القرن (بدون التوسعات المستقبلية على الأمد البعيد) (*) .

وعلى مستوى « **المراكز الرئيسية** » لهذه المجتمعات . يتفاوت نصيب الفرد من الخدمات العامة ما بين ادناها : ٧ر١ ــ ٩ر١م٢ على التوالى فى ١٥ مايو و٦ أكتوبر (١١) ، وبين أقصاها : ٧٥ر٤م٢ فى العامرية . وهذا المعدل الأخير يشكل اكثر من ثلاث مرات نظيره فى السادات الذى يبلغ ٢ر٤م٢ لكل فرد من الخدمات العامة ، ويرجع هذا المعدل الكبير فى مدينة العامرية ، بسبب تخصيص خدمات : تجارية ــ ادارية ــ ترفيهية ، يبلغ نصيب كل فرد منها على التوالى مساحات : ٦٤ر. ــ ٧ر٣ ــ ٩٢ر٢م٢ ، فى حين تنخفض هذه المعدلات ، على التوالى الى : ٣١ر. ــ ٧٥ر. ــ ٠٩ر١م٢ لكل فرد فى مدينة السادات .

٢ ــ المناطق السكنية :

سكان المجتمعات العمرانية الجديدة يتم توزيعهم أما على ثلاث مناطق سكنية رئيسية ويتفاوت عدد سكان كل منطقة سكنية ما بين ٥٠ الف نسمة فى ١٥ مايو ، ١١٠ ــ ١٢٠ الف نسمة فى ٦ اكتوبر ، و١٤٠ ــ ١٨٠ الف نسمة فى العامرية ، أو على ٤ مناطق رئيسية يتراوح عدد سكان كل منطقة ما بين ١٠٠ ــ ١٥٠ الف نسخة فى مدينتى السادات والعاشر من رمضان .

ومعدلات نصيب الفرد من الخدمات العامة على مستوى المناطق السكنية ، تشير الى تفاوتا كبيرا ، فبينما تخصص مدينة ٦ اكتوبر للخدمات : الصحية ــ الثقافية ــ ادارية ــ الاجتماعية مساحة ٢ر.م٢ لكل فرد ، نجد هذا المعدل يرتفع الى ١ر١ ــ ٢٦ر١م٢ على التوالى فى مدينتى ١٠ رمضان والسادات ، ثم يصل المعدل الى أقصاه اذ يبلغ ٥ر٢ ــ ٥٦ر٢م٢ على التوالى فى مدينتى ١٥ مايو والعامرية .

٣ ــ الأحياء السكنية :

يتراوح عدد الاحياء السكنية ــ فى كل منطقة سكنية ــ ما بين ٢ حى سكنى يضم كل منهما ٢٥ الف نسمة فى ١٥ مايو ، الى ٣ أحياء تستوعب

(*) استهدفت التخطيط على الامد البعيد فى القرن القادم ، أن تستوعب كل من السادات والعامرية الجديدة مليون نسمة .

ما بين ٤٦ – ٦٠ الف نسمة فى العامرية ، الى ٤ أحياء تضم ما بين ٢٤ – ٣٦ الف نسمة فى كل من مدينتى السادات و١٥ رمضان وتتخلل الأحياء السكنية « **المراكز الفرعية** » للخدمات العامة . ومعدل نصيب ما يخصص للفرد للقيام بكافة الأنشطة الخدمية يبلغ أقصاه (٩ر٧م٢) فى مدينة ٦ أكتوبر أما أدنى معدل فنجده فى مدينة السادات (٨٣ر١م٢) ويمكن تعليل سبب هذا التفاوت الضخم الى أن المخطط العام لمدينة ٦أكتوبر يخصص مساحات لكل فرد من الخدمات : التعليمية – التجارية – الترفيهية تبلغ على التوالى : ٣ – ٩ر٠ – ٦ر٢م٢ بينما تنخفض هذه المعدلات على التوالى الى : ٤ر٠ – ٣ر٠ – ٦م٢ فى مدينة السادات .

٤ – الوحدة التخطيطية :

تعتبر المجاورة السكنية، «الوحدةالتخطيطية» فى المجتمعات الجديد، ويتفاوت عددها مابين ٦– ١٠ مجاورة بكل حى سكنى . وغالبا ، يبلغ عدد سكان كل مجاورة ما بين ٤ – ٢ر٤ الف نسمة على التوالى ، وفى بعض الحالات ، يزداد عدد سكان المجاورة ليصل الى ٦ – ٧ الف نسمة على التوالى فى السادات والعامرية .

ونتبين من الشكل رقم (٤) ، أن نصيب الفرد من الخدمات العامة على مستوى المجاورة يبلغ حده الأدنى ٦ر٢م٢ ، ثم يرتفع الى ما بين ٦ر٣ – ٤م٢ على التوالى فى السادات والعامرية ، ثم يرتفع الى حدوده القصوى ٥ر٧ – ٣٢ر٨م٢ على التوالى فى ٦ أكتوبر و١٠ رمضان .

ان التصور أو المفهوم التخطيطى ، الموضح بالشكل رقم (٥) يشير الى المعدلات التخطيطية التى اتبعت ومعايير تنظيم الأراضى ، لذوى النص المحدود /- المتوسط . ويهدف هذا التصور الى ايجاد أصغر تجمع سكنى متكامل يقام بالقرب من أماكن الانشطة الانتاجية ومزود بالخدمات العامة – اليومية والمسطحات الخضراء وأماكن الترفيه لتهيئة ظروف معيشية مناسبة ومناخ ملائم ، مما ينعكس على حياة ساكنيه وانتاجهم ، ويمكن لهذه الوحدة التخطيطية ان تنمو طبقا للتوسعات الانتاجية / عمرانية المنتظرة .

وتهدف فكرة التقسيم الى أربع كتل سكنية، للوصول الى محيط معيشى مناسب للسكان ، وكذلك حماية الروابط الاجتماعية وتدعيمها من خلال احترام العادات والتقاليد المدوروثة والتى تؤثر بشكل مباشر على الفكرة التخطيطية وكذا على الخدمات المطلوبة – والتى نجدها فى المجتمع المصرى والممثلة فى « مجتمع الشارع » أو الحارة، وهى مجموعة من السكان متقاربين ومتجانسين اجتماعيا / اقتصاديا ومنتمين « للحارة » (١٢) مكونين مجتمع أصغر من المجتمع السكنى ككل (الوحدة التخطيطية) – اى أن هناك شارع او عصب رئيسى لكل كتلة سكنية (١٢٠٠ نسمة اى ما يعادل ٢٤٠ أسرة) ومن هنا تنشأ بعض الخدمات البسيطة اللازمة لهم مكونة « بؤر صغيرة » من الخدمات تؤدى فى نهايتها الى مركز الوحدة التخطيطية الرئيسى .

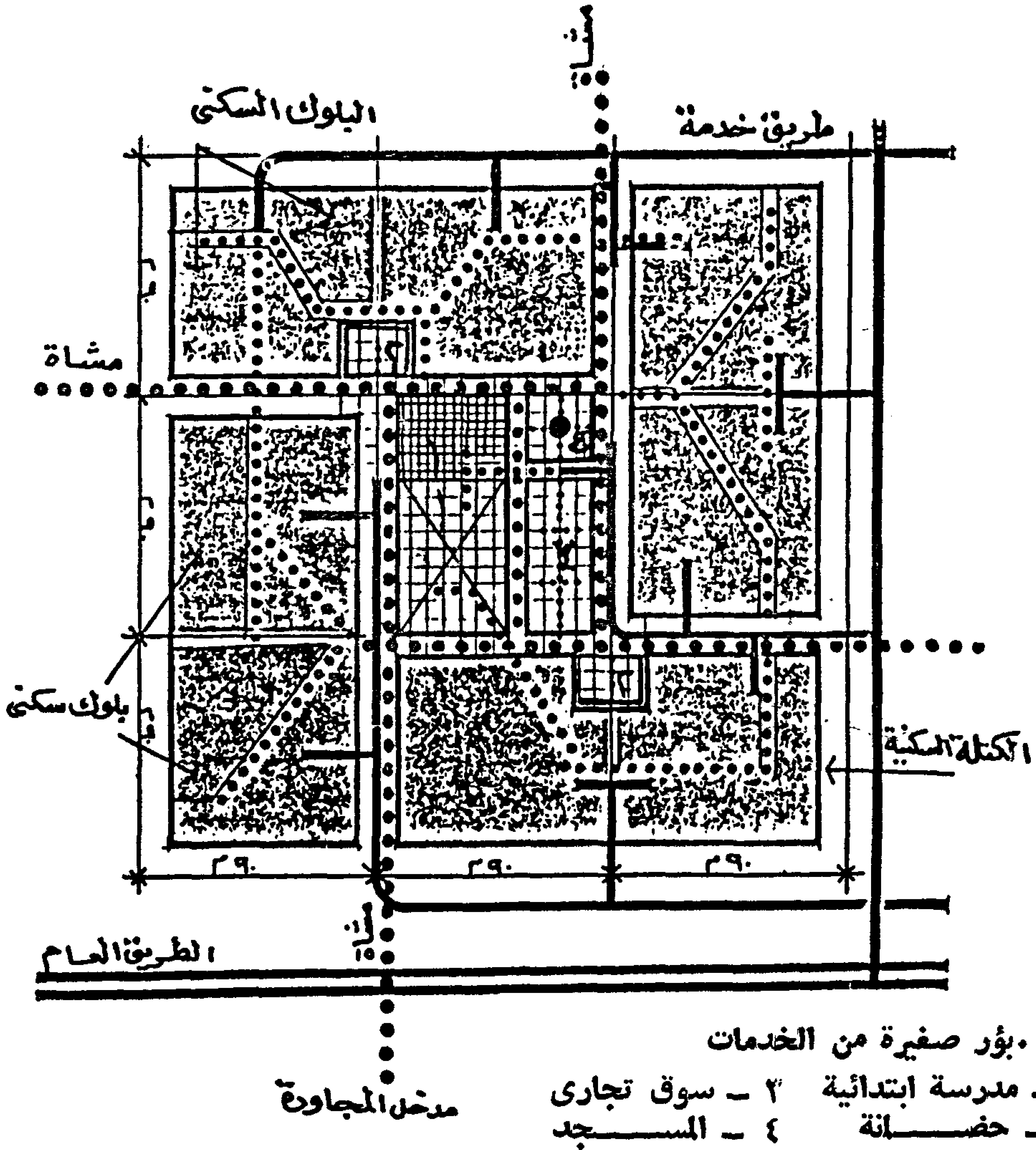
ويلاحظ أن « معدلات تنظيم الأراضى » السابق ذكرها تتفق الى حد بعيد مع خلاصة الدراسات والأبحاث العديدة التى تناولت مسح لبعض المناطق السكنية التى يسودها تجمعات « الاسكان الخاص » – المرخص / العشوائى لذوى الدخل المحدود المتوسط .

خامسا – مشروعات اسكان النقابات :

يشير الشكل رقم (٦) للوحدة التخطيطية (غير التقليدية) المقترحة لمشروعات اسكان النقابات من فئات الدخل المحدود ، وموضحا بها المقومات الاقتصادية / الاجتماعية للمستفدين وكذلك مقومات الحل المقترح . ونجاح هذا التصور التخطيطى ، مشروط بتحقيق الآتى :

(أ) تصميمات النماذج السكنية :

ان عملية وضع التصميمات الهندسية والمعمارية ، يجب أن يتم فى ضوء الدراسات التطبيقية لحاجات الأفراد المقرر اقامة المشروعات السكنية لهم . وتقوم بهذه المهمة النقابات النوعية / المهنية المختلفة ، تحت اشراف وزارة الاسكان والتعمير – اذا ما اريد اشباع هذه الحاجات ، بما يكفل تحقيق الرضا والأمن الذاتى للمستفدين .



....بؤر صغيرة من الخدمات
١ ـ مدرسة ابتدائية ٣ ـ سوق تجارى
٢ ـ حضـــانة ٤ ـ المســـجد

المعدلات التخطيطية :

مساحة الوحدة التخطيطية (المجاورة السكنية) = ٣٨ر٧ هكتار (٢٧٢ × ٢٧٢ م).

عدد السكان المقدر = ٤٨٠٠ نسمة ، الكثافة السكانية الصافية = ٦٥٠ شخص / هكتار .

الاستعمالات السكنية ٨ر٤ هكتار ، حدائق ومسطحات مفتوحة ٥٢ر. هكتار .

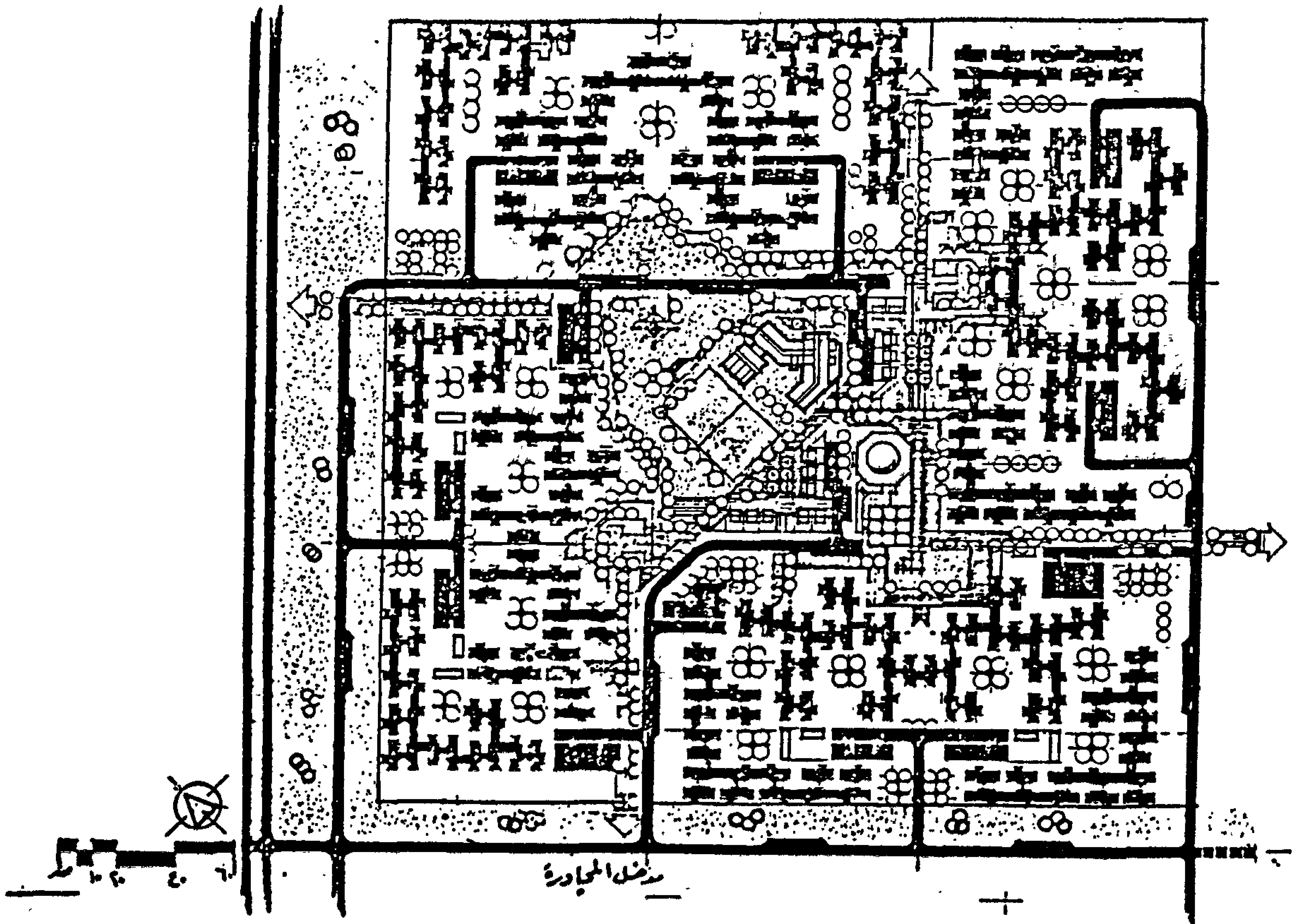
الخدمات العامة ٨١ر. هكتار ، مســـارات الحركة ٢٥ر١ هكتار .

تنظيم الأراضى :

الوحدة التخطيطية = ٤ كتلة سكنية ، الكتلة السكنية بمساحة ٢ر١هكتار، تضم ١٢٠٠نسمة، والكتلة موزعة على ٤ بلوكات سكنية، وكل بلوك يضم ٣٠٠ نسمة ، وبمساحة ٣٠٠٠ م٢ (٢٧م × ١١٠ م) وتحيط به شوارع من جهاته الأربع ، ومقسم الى ٢٢ قطعة سكنية ، مساحة كل منها فى حدود ١٤٥م٢ (١٠م × ٥ر١٣م) ، وكل منها مقام عليه مبنى من ثلاث أدوار ، كل دور يحتوى على وحدة أو وحدتين سكنيتين .

شكل (٥)

الوحدة التخطيطية المتقرحة لمشروعات الاسكان لفئات الدخل المحدود / المتوسط .



المقومات الاقتصادية / اجتماعية :

ـ الدخل العام السنوى محدود ـ ولكنه ثابت ومستقبلا يزداد باطراد .

ـ أسر محدودة العدد (٤ افراد من الشباب خريجى الجامعات والمعاهد العلمية من المهنيين اعضاء النقابات) .

ـ العادات والتقاليد : الأغلبيـة حضريا ـ الأقلية حضرى / متريف .

مقومات الحل :

(انظر شكل رقم ٥)

ـ عدد السكان المقدر ٤٨٠٠ نسمة .

ـ عمارات سكنية تحوى ١٢٠٠ وحدة / المجاورة .

ـ المسطح المعيشى من ٦٠ م٢ ـ ٨٠ م٢ ـ حجرتين وصالة ومنافع .

ـ المسكن بايجار مع دفع مقدم يعادل ٣ سنوات (ايجار) ، قيمته تتزايد بنسبة بسيطة سنويا تبعا لتزايد الدخل السنوى للسكان .

شكل (٦)

الوحدة التخطيطية المقترحة (غير التقليدية) لمشروعات اسكان النقابات من فئات الدخل المحدود .

ويجب توافر دليل العمل المهنى (Code of Practice) ، الذى يجب ان يلتزم به المهندسون فى سبيل وضع التصميمات الجيدة للنماذج السكنية ، وعلى أن يضم ادلة العمل الفنية المهنية ، ويتولى تقرير المبادىء الأساسية له ، وما يتفرع منها من التفصيلات والتنظيمات الادارية الهندسية ، التى تتمثل فى نقابة المهندسين واتحاد المعماريين المصريين .

(ب) المعايير الأساسية لدليل العمل المهنى :

ـ ان يراعى متطلبات المستفدين وطريقة معيشتهم مع استمرار عمل المسح الاجتماعى الموقعى لكل مشروع على حده .

ـ مراعاة الاقتصاد فى التصميم الذى ينعكس على كافة التنفيذ .

ـ اختيار انسب الحلول المناسبة لقلة تكاليف فترة الصيانة والمواد واساليب التنفيذ .

ـ «التوحيد القياسى» (Standardization) لجميع المواصفات المتعلقة بمواصفات الوحدات والأجزاء المتكررة فى المساكن لتوافر الجودة ، بما يناسب الأغراض والاستعمالات .

ــ استخدام التصميمات الهندسية والمعمارية التى تكفل العزل الحرارى والاقتصاد فى استهلاك الطاقة .

ــ اختيار الحلول التصميمية التى تهدف للاستفادة من الموارد الاقتصادية المحلية المتاحة وتقليل الاعتماد على الخارج بقدر الإمكان .

ــ دعم التصميمات المعمارية التى تبرز الطابع المحلى والتراث الحضارى للموقع والاقليم الجغرافى . فلقد بات معروفا الآن أن الأغنياء بالتراث المعمارى المتوارث عن الآباء والاجداد يعتبر من « البواعث » على التقدم والارتقاء .

ــ رفض محاولات الأجهزة المعنية تعميم « النمذج النمطية » السكنية (Prototypes) على مستوى الجمهورية بأقليمها ومواقعها الجغرافية المختلفة ــ بدعوى خفض تكاليف « التصميمات الهندسية » وتحقيقا لأهداف السرعة والانتاج الضخم !

* * *

التوصيات :

١ ــ حلول الاسكان المطروحة حاليا ، لايستفاد منها أعضاء النقابات ، سوى العاملين فى الخارج، مما يتوفر لديهم من مدخرات ، ولذلك فكثير ما تؤدى المعدلات الطبيعية المرتفعة بأكثر مما يلزم الى اسكان نسبة صغيرة من مجموعات الدخل على نحو ممتاز، بينما تظل تكلفة توفير المسكن مرتفعة الى حد لا يسمح بتقديمه للغالبية العظمى فتكون ظروف معيشتهم غير مناسبة على الاطلاق .

٢ ــ يمكن تحقيق ضغط التكاليف من خلال تغيير بعض أساليب التخطيط الراهنة عن طريق خفض المستويات المرتفعة وحجم قطع الأراضى ، بهدف مواجهة الطلب على الاسكان لفئات الدخل المنخفض والمتوسط فى مواقع توطين جديدة .

٣ ــ دفع العمران من المراكز العمرانية الحالية الى الاقاليم الصحراوية ، بمواقع تسمح بخلق أنشطة اقتصادية جديدة تسمح بالتنمية وتخلق فرص عمل جديدة ، ومما يؤدى بدوره الى خلق مراكز توطين جديدة للشباب بدلا من الحلول المتبعة فى المشروعات الحالية . ويتطلب ذلك اقامة توازن بين مختلف الفئات الاجتماعية والاقتصادية ومواقع العمل والاقامة وتنظيم التعمير حول محاور التنمية ، مثل مراكز الخدمات والأنشطة وأخيرا توفير المرونة التخطيطية / التصميمية ، بما يسمح بتحقيق التكيف الذى يطرأ فى المستقبل .

* * *

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الخطوط العريضة للتخطيط السياحى وتطبيقها على ساحل البحر الأحمر

مهندس ماجد محمد المهدى

حبى الله مصر بطبيعة جميلة من شواطىء وجزر وشعاب مرجانية .. هذا الى جانب الحضارات التى مرت عليها من حضارة فرعونية واغريقية ورومانية ومسيحية واسلامية ومعاصرة .. حيث تركت كل منها آثارها وبصماتها الواضحة عليها والتى قلما تتوافر فى اقليم ما .. برغم ذلك كله فنصيب مصر من السياحة الخارجية ضئيل جدا .

ولما كانت السياحة من العناصر الموجبة فى موازين المدفوعات والدعامة الاقتصادية الأولى لكثير من الدول السياحية ... ولما كانت السواحل المصرية وخاصة الشرقية منها غير مستغلة الاستغلال الذى يتلائم مع مالها من مكانة لذا كان من الضرورى النظر الى هذه المنطقة بعين الاعتبار ووضع خطة لتنميتها .

ـ تعتمد استراتيجية تنمية ساحل البحر الاحمر سياحيا على عاملين اساسيين .

العامل الأول :

* هو دراسة السوق السياحى بتدرج مستوياته سواء دوليا : والذى تدل مؤشراته على ارتفاع نسبة حجم السياحة الترفيهية بالمقارنة بحجم السياحة الثقافية التقليدية وهو مؤشر له دلالته وتأثيراته على المستويات الدنيا .

ـ تفوق نسبة حجم الحركة السياحية الاجتماعية لذوى الدخول المحدودة على نسبة حجم الحركة السياحية الراسمالية أو سياحة الاغنياء .

ـ انخفاض مدة الاقامة السياحية مع ارتفاع معدلات الانفاق .

* أو على المستوى القومى : والذى تدل مؤشراته على انخفاض نسبة حجم الحركة السياحية الداخلية بالمقارنة بحجم السكان نظرا للظروف الاقتصادية الراهنة مع ارتفاع أسعار الفنادق والرحلات السياحية .

ـ انخفاض مدة الاقامة أيضا مع انخفاض معدلات الانفاق .

* أو على المستوى الاقليمى : حيث نجد من دراسة اتجاهات الحركة السياحية الاقليمية ونسب توزعها أنها تنحصر فى أطار سياحى ترفيهى تقليدى يتمثل فى الساحل الشمالى الغربى بوجه عام والاسكندرية بوجه خاص مع أهمال منطقة البحر الاحمر لحد ما .

ـ ظهور أقاليم سياحية قوية منافسة لاقليم البحر الاحمر فى جذب السياحة الخارجية منها أقليمى سيناء وقناة السويس .

* أما على المستوى المحلى نجد أن الحركة السياحية للبحر الاحمر يتحكم فيها عاملين احدهما رئيسى ويتمثل فى السياحة الترفيهية الغير تقليدية من سياحة الشواطىء وما يتعلق بها من رياضات مائية .. وتعتمد غالبا على السياحة الخارجية والآخر تيار فرعى ويتمثل فى سياحة المزارات الدينية والمتمثلة اساسا فى مزار أبو الحسن الشاذلى وديرى الانبا بولا والانبا انطونيوس .

من هذه النظرة السياحية يتضح لنا أن الحركة السياحية للبحر الاحمر عبارة عن سياحة ترفيهية غير تقليدية متمثلة فى الغطس والصيد والتصوير والرياضات المائية الأخرى والتى تتركز مقوماتها بمثلث قاعدته راس جمسه ـ راس محمد ـ وراسه الغردقة ، وتسيطر على هذا النمط السياحى السياحة الخارجية والمتمثلة فى سياحة رجال الاعمال والسياحة الاجتماعية ، وكل منها له اسلوبه واحتياجاته السياحية من متطلبات اسكان سياحى وخدمات مباشرة وغير مباشرة تختلف الى حد كبير فى معدلاتها ومعاييرها عن السياحة الداخلية والتى تمثل نسبة ضئيلة وهى ايضا لها متطلبات واحتياجات يجب تنميتها والعناية بها حتى تزداد هذا الى جانب سياحة المزارات الدينية سواء الاسلامية والمتمثلة اساسا فى مزار ابو الحسن الشاذلى بمنطقة مرسى علم وتطفى على هذا الاتجاه السياحة الداخلية القادمة من مدن صعيد مصر وهم ذوى دخول متوسطة أو محدودة ومتطلبات

هامشية وغالباً ما يأتون بقصد الزيارة والبحث عن فرص عمل موسمية .

أو السياحة المسيحية والمتمثلة فى ديرى الانبا بولا والانبا انطونيوس بمنطقة راس غارب .

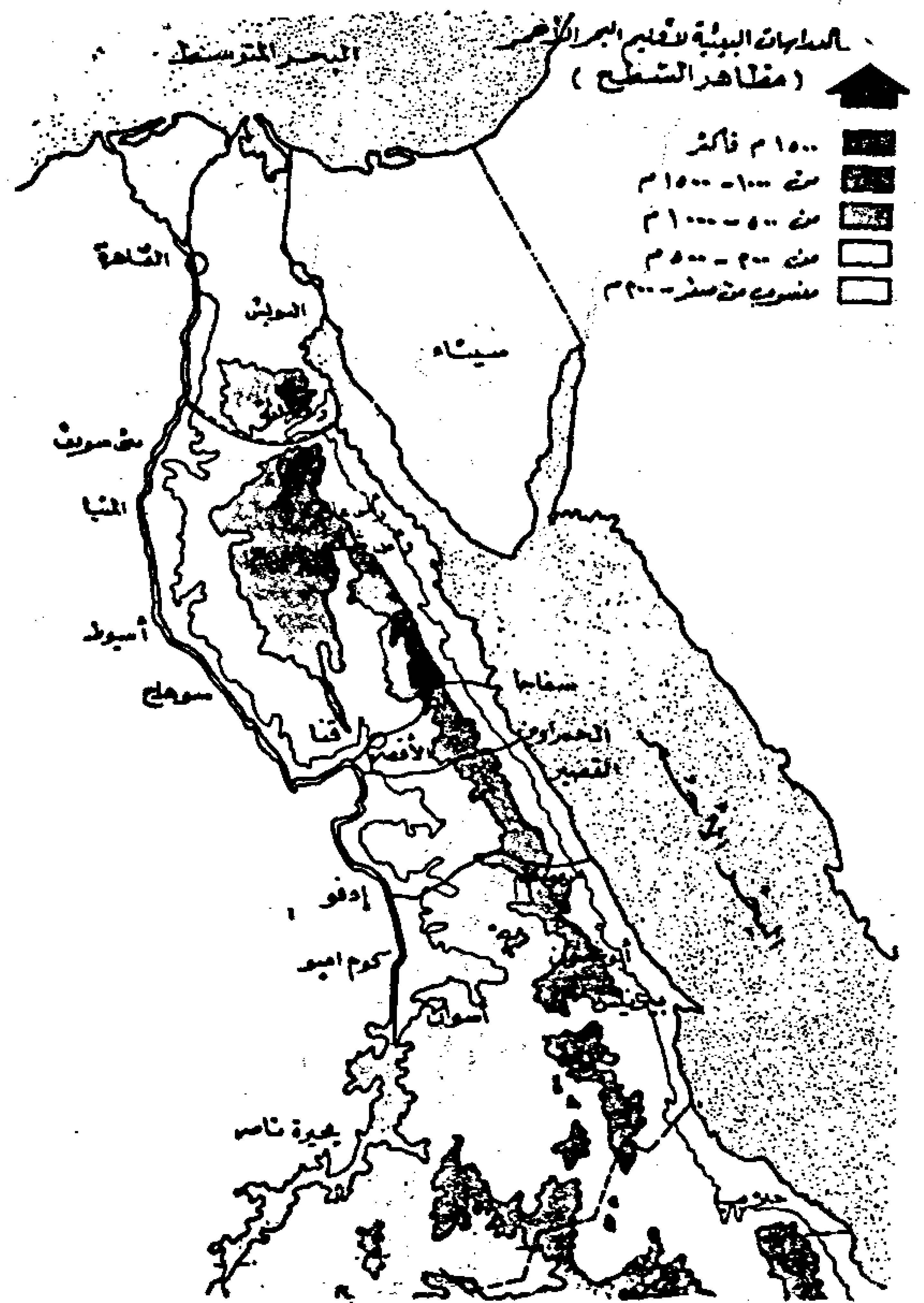
وبدراسة هذه الاتجاهات وتطورها فى ضوء الاعتبارات والعوامل السياحية والتى ظهرت من دراسة السوق السياحى يمكن التنبؤ بحجم الحركة السياحية المستقبلية للمنطقة واتجاهاتها وخصائصها ومتطلباتها حيث يجب توفيرها من خلال خطة التنمية السياحية والتى سوف يبرزها العامل الثانى وهو عملية المسطح الشامل للأقليم مع التركيز على مناطق الطلب السياحى الحالية .

العامل الثانى :

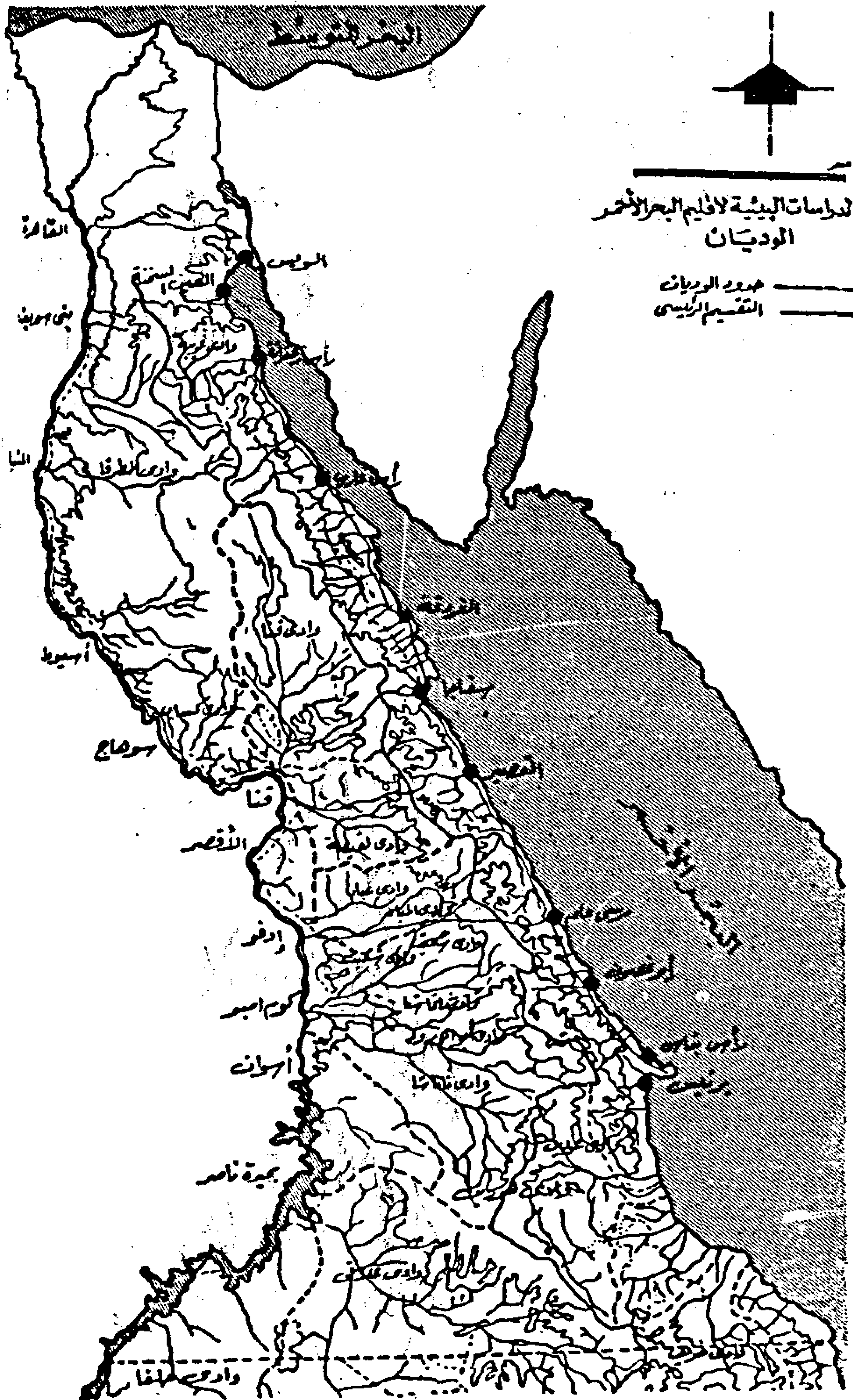
فهو تنمية لكافة موارد وامكانات الاقليم من خلال عملية مسح شامل والتى ربما قد تظهر مناطق صالحة للاستغلال السياحى غير مطروقة من قبل .. مناطق تنمى سياحياً وكان من الاجدى تنميتها صناعيا .. وهكذا .. وتأتى فى مقدمة الدراسات الدراسة البينية للاقليم وعلى راسها طبيعة موقع البحر الاحمر .

فموقع الاقليم الجغرافى المتوسط ما بين القارات من العوامل الموجبة فى تنشيط الحركة السياحية هذا بالاضافة الى تاثيره على تشكيل عناصر المناخ المعتدلة على مدار السنة والتى تميز البحر الاحمر عن سائر المسطحات المائية الأخرى بالدفء مما أثرى مياهه بالكائنات والتى تعدت الى اكثر من ٨٠٠ نوع من الكائنات البحرية والشعاب المرجانية وهما أهم مقومات السياحة الخارجية للمنطقة .

كما أن تضاريس المنطقة المتباينة من سلاسل جبلية مرتفعة والتى يبينها الشكل رقم (١) وهضاب أثرت على الشكل العمرانى للتجمعات وحدت من نموها فى اتجاه وادى النيل اللهم الا عن طريق مجموعة السهول والوديان العريضة كما يبين الشكل رقم (٢) والتى سهلت من الربط ما بين البحر والوادى .



شكل رقم (١) *



شكل رقم (٢) *

* Ministry of Development & new Com munities. : R.S.G. Regional Plan Satec-1978.

كما أن الموقع الجغرافى وتعاقب الأزمنة الجيولوجية على المنطقة قد أثراها بالثروات الطبيعية من صخور ومعادن تنتشر على طول المنطقة الساحلية كما يبين الشكل رقم (٣) ومصادر طاقة تتركز فى منطقة خليج السويس وتتمثل أساساً فى البترول والذى يؤثر الى حد كبير فى تلوث المنطقة الشاطئية من رأس الزعفرانة الى رأس الجمسة مما قد يتسبب فى تدمير الشعاب المرجانية المتاخمة لهذه الشواطىء وبالتالى أحجام الحركة السياحية عنها .

ويتضح من تحليل هذه الدراسة كما يبين الشكل رقم (٤) المناطق الصالحة التنمية السياحية وهى ذات مواقع يتميز البعض منها بطبيعة جمالية وخصائص معينة ترقى بها الى المستويات السياحية الدولية منها على سبيل المثال منطقة رأس جمسة ، سهل حشيش ، أبو الدرج .. ويبينها الشكل رقم (٥) .

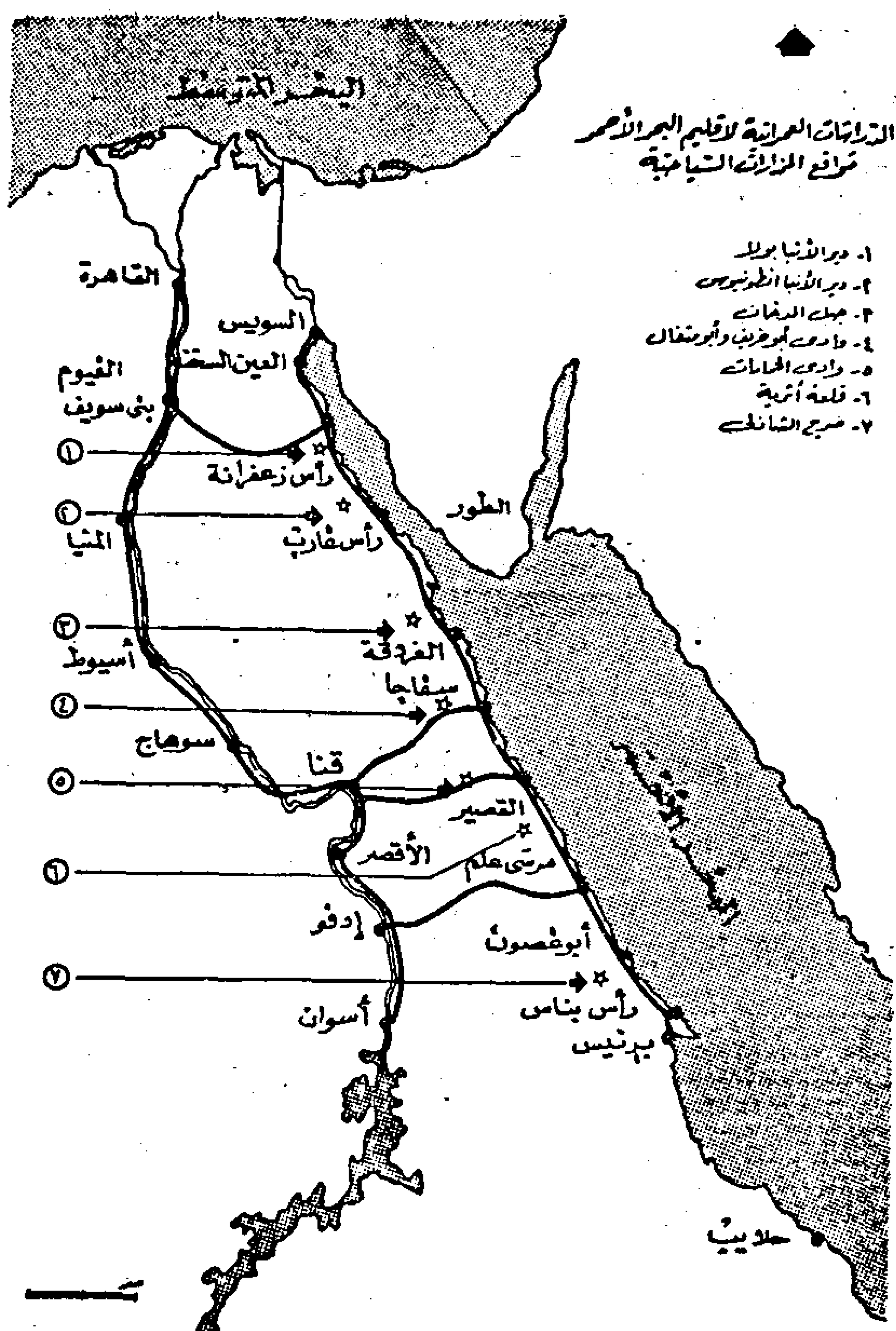
شكل رقم (٣)

مناطق مستوية متاخمة للساحل تصلح لاقامة التجمعات العمرانية كمرحلة أولى .
مناطق مستوية قريبة من الساحل تصلح لاقامة التجمعات العمرانية كمرحلة ثانية .
أتجاهات للخروج الى المناطق الصحراوية القريبة .
مناطق جبلية غير مستوية لاتصلح لاقامة التجمعات العمرانية الا أنها تتوافر بها الثروات المعدنية ومواد البناء .
مناطق صحراوية ذات طبيعة قاسية لاتتوافر بها أى مقومات طبيعية .
مناطق صالحة للاستغلال الزراعي المستقبلى لخصوبة تربتها وأرتفاع منسوب المياه الجوفية بها
مناطق تلوث بترولى تحد من نشاط الاستغلال السياحى الحالى أو المستقبلى .
ابار البترول المنتشرة بخليج السويس وتمثل انتاجها ٨٠٪ من اجمالى أنتاج الجمهورية .
الوديان المنتشرة بالصحراء الشرقية والتى يمكن استغلالها فى الربط مابين وادي النيل والبحر الاحمر باقامة الطرق والسكة الحديدية .
أتجاه الرياح السائد والذى يمكن أن يحدد مواقع استعمالات الاراضى داخل أو خارج التجمعات .
الاتجاه السائد للتيارات البحرية والذى يمكن أن يحدد مواقع الموانى ومداخلها .
منطقة غابات غنية الذاخرة بالنباتات الطبيعية والحيوانات البرية والتى يمكن استغلالها كمزار سياحى الا انها منعزلة عن الطرق والتجمعات العمرانية .
مواقع سياحية شاطئية قابلة للتنمية السياحية بأختلاف مستوياتها .
منطقة تركز الجزر والشعاب المرجانية وهى أهم مناطق الجذب السياحى الخارجى للمنطقة .
خلجان طبيعية صالحة لاقامة الموانى والمراسى .
خلجان طبيعية صالحة للاستغلال السياحى .
مواقع مراكز الزلازل ودوائر تاثيرها يجب وضعها فى الحسبان عند اقامة المشروعات السياحية

شكل رقم (٤)

الدراسات البيئية السياحية لاقليم البحر الأحمر
المواقع الشاطئية الصالحة للاستغلال السياحى

شكل رقم (٥) ٭



شكل رقم (٦)

ثم تنتقل الدراسة الى استعمالات ارض الاقليم وبنيته الاساسية لتبرز أهم معوق امام حركة التنمية سواء العمرانية او السياحية وهى ضعف الموارد المائية الحالية برغم تعدد مصادرها ، والتى تخدم أقل من نصف عدد السكان الحالى ذلك فى حالة الأخذ بمعدلات الاستهلاك المثالية ـ ثم تستطرد الدراسة فى حصر لهذه الموارد مع وضع خطة ترقى بها لتتماشى مع التنمية السياحية المرتقبة المنطقة ـ ويبين شكل رقم (٦) مواقع أهم المزارات السياحية وعلاقتها بالتجمعات العمرانية وشبكة الطرق أما الشكل رقم (٧) فهو تحليل عام لاستعمالات الاراضى خارج التجمعات .

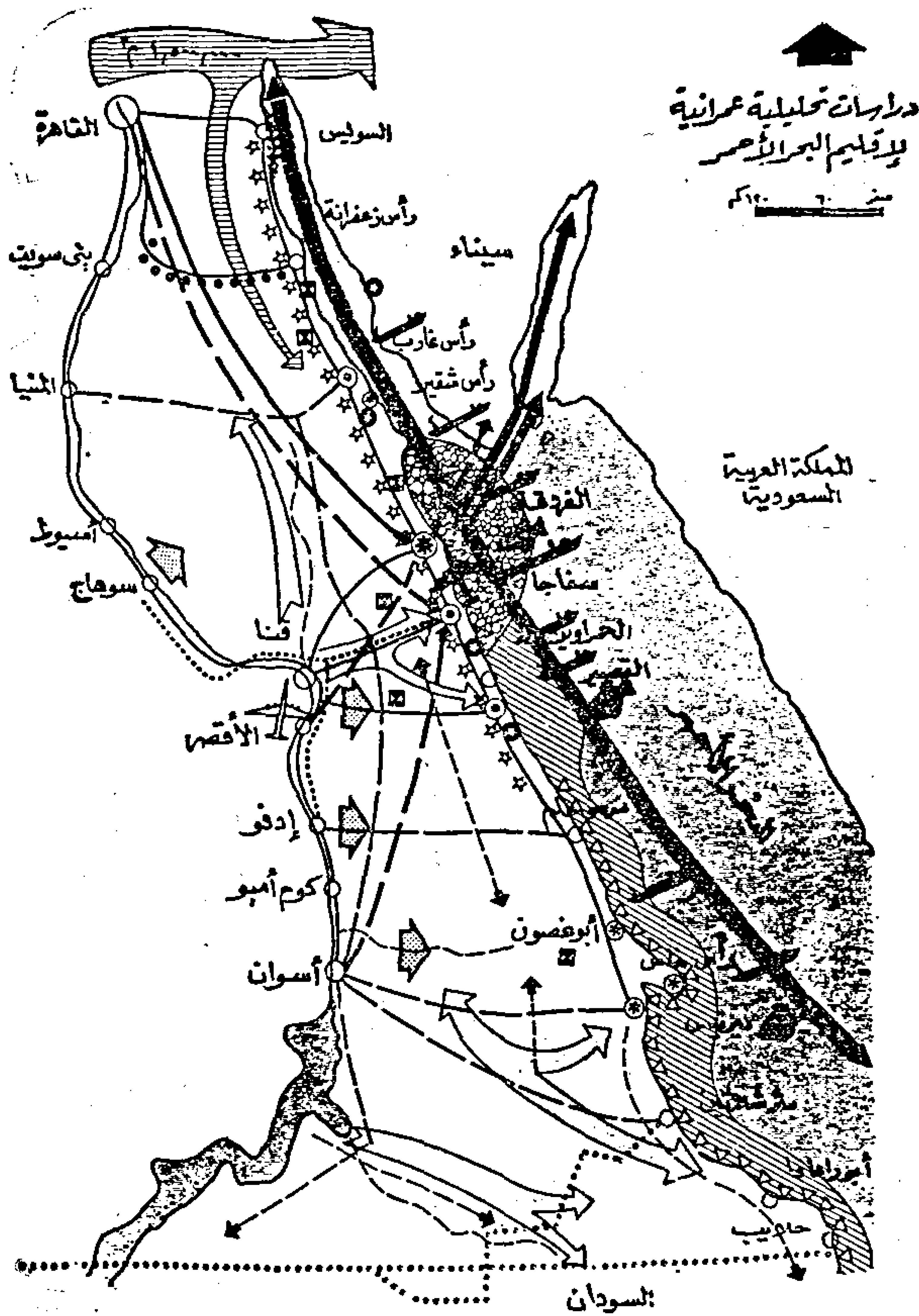
ويتطرق البحث من خلال عملية المسح الشامل الى السكان وخصائصهم ومعدلاتهم الحيوية وكفاءة ما يقدم لهم من خدمات حيث يمثلون القوى البشرية والتى يمكن استخدام جزء منها فى مجال العمالة السياحية .

وفى النهاية تأتى التوقعات المستقبلية لما سوف يؤل اليه الحجم السكانى الحالى واحتياجاته من الخدمات ويبين الشكل رقم (٨) تحليل عام للدراسات السكانية .

ثم يتناول البحث بالدراسة المقارنة القطاعات الاقتصادية الهامة من صناعة وزراعة وصيد وسياحة مع التركيز على قطاعى الصناعة والسياحة حيث يبرز أهمية الصناعات الاستخراجية وخاصة البترول كعنصر اقتصادى منافس لسياحة وأفضليات تنمية المواقع المختلفة ويوضح شكل رقم (٩) مواقع المشروعات الصناعية وبشىء من التفصيل لقطاع السياحية حيث تناول دراسة بعض المشروعات السياحية الحالية (ويبين شكل رقم (١٠) بعض نماذج لها) ـ مع عمل حصر للطاقة الفندقية والتوقعات المستقبلية لها ويوضح شكل رقم (١١) دراسة تحليلية اقتصادية للاقليم .

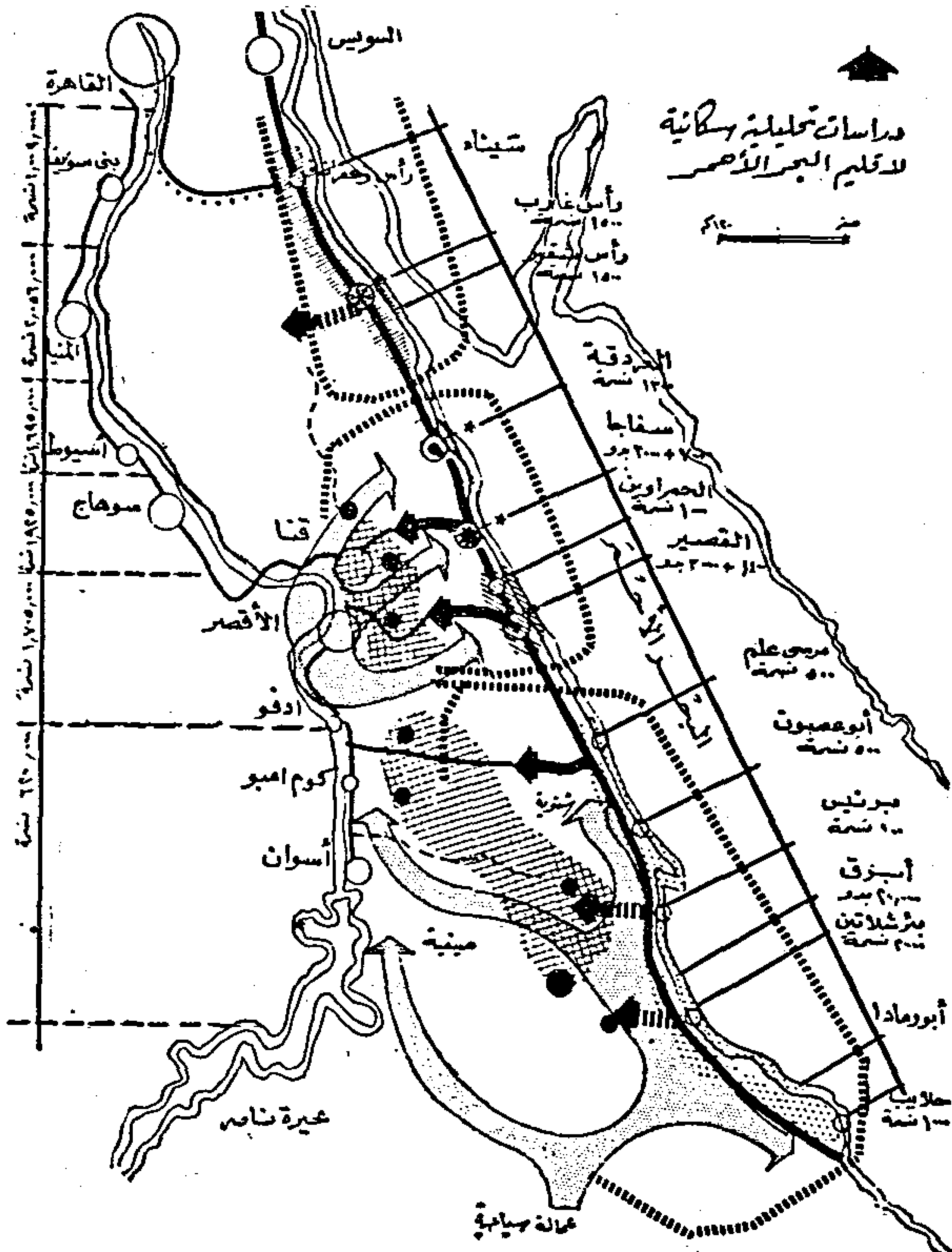
وفى نهاية هذا الخط تتبلور موارد وامكانات الاقليم من خلال عملية المسح الشامل فى صورة تحليل عام لامكانية استغلال المناطق ـ شكل رقم (١٢) مع وضع تصور للانشطة الوظيفية للتجمعات الساحلية كما يبينها الشكل رقم (١٣) .

(٭) وزارة السياحة : المواقع السياحية على ساحل البحر الاحمر (القاهرة ـ ١٩٨٠) .



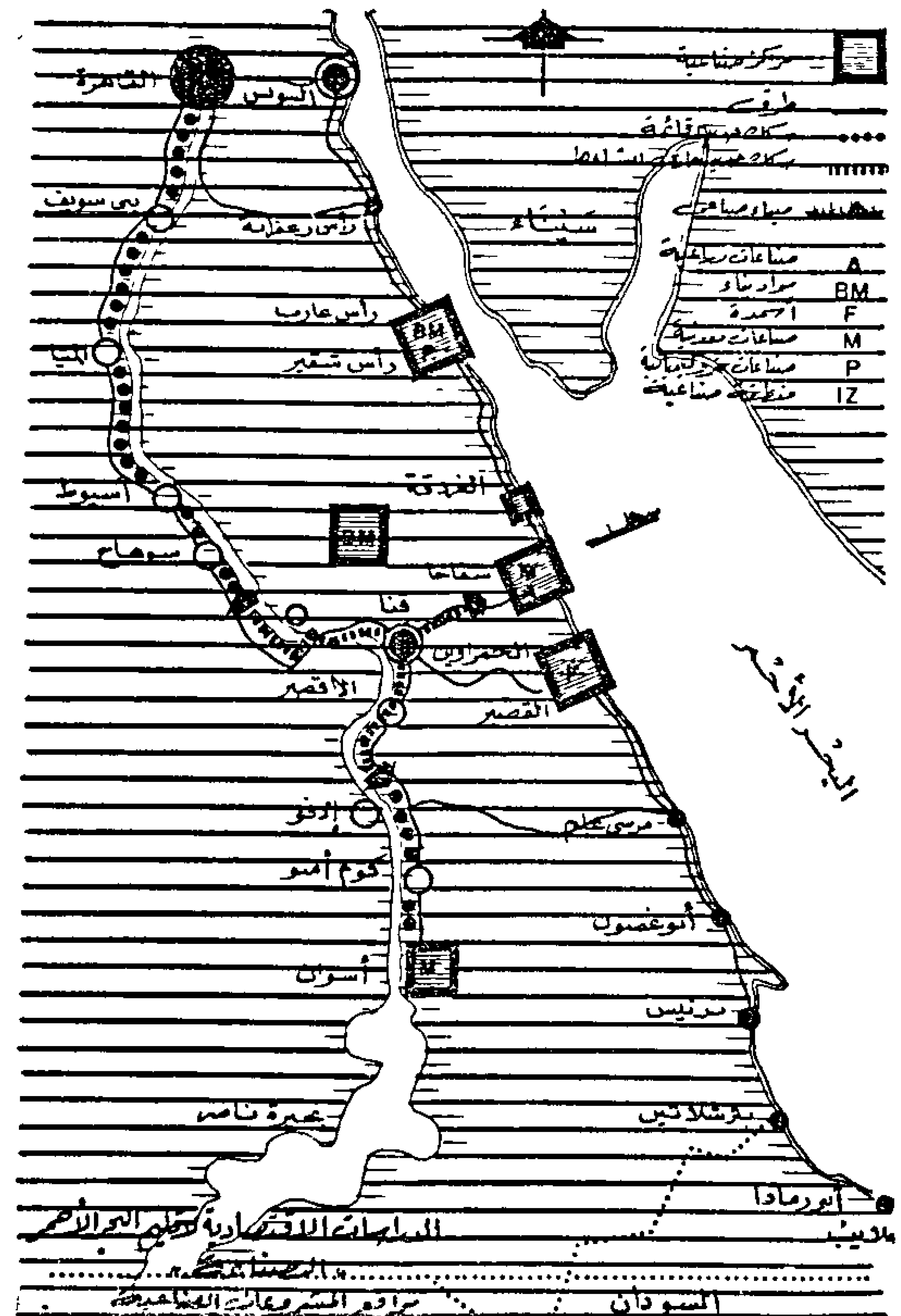
- تجمعات عمرانية استعمالات الاراضي الرئيسية بها السياحة .
- تجمعات عمرانية أستعمالات الاراضي الرئيسية بها صناعة وتعدين .
- تجمعات عمرانية توجد بها مراكز سياحية يمكن تنمية استعمالات أراضيها لتصبح السياحة هي النشاط الغالب .
- شبكة الطرق الحالية ترتبط تجمعات البحر الاحمر بعضها ببعض وبمدن وتجمعات وادى النيل .
- شبكة الطرق المقترحة لخدمة التجمعات العمرانية الناشئة والحركة السياحية .
- مسار خط سكك حديدية مقترح يخدم حركة النقل التجارى والصناعى مابين سفاجا وقنا .
- ميناء سفاجا أكبر الموانئ التجارية الصناعية المقترح تنميتها على سواحل البحر الاحمر لتخدم الاقليم والوادى .
- مراسى تجارية صغيرة يمكن أستغلالها فى التنقل السياحى البحرى وكمراسى لليخوت والعبارات التى تخدم السياحة .
- موانى صيد يجب وضع خطة لاستغلالها بحيث لاتتعارض وخطة التنمية السياحية للاقليم
- المسارات البحرية الحالية يمكن استغلالها فى خدمة السياحة وجذب الحركة السياحية الى المنطقة .
- مسارات بحرية مقترحة لخدمة منطقة الجزر والمواقع السياحية شرق سيناء .
- مطار الغردقة يمكن تنميته كمطار دولى أن يخدم الحركة السياحية الخارجية .
- مهابط طائرات تحتاج الى تنمية وتجهيز لتخدم حركة الطيران الداخلى بحسبما يتراءى فى خطة التنمية .
- مسارات جوية حالية تربط مابين القاهرة والغردقة .
- مسارات جوية مقترحة تخدم حركة التنقل مابين القاهرة وسفاجا ، مسارات أخرى تربط مابين الاقصر وأسوان والغردقة وسيناء (أهم مناطق الجذب السياحى بالجمهورية) .
- مواقع سياحية شاطئية يمكن أن تستغل فى خطة التنمية السياحية .
- منطقة تركز الجزر والشعاب المرجانية أهم مقومات الجذب السياحى للمنطقة .
- مزارات سياحية .
- مناطق وتجمعات مخدومة جيدا بوسائل الاتصال (طرق ، سكة حديدية) ، بالمرافق الاساسية (مياه ، كهرباء) .
- مناطق محرومة من المياه النقية يمكن امدادها لوحدات تحلية مياه البحر .
- اتجاهات وأحجام شبكات المياه المقترحة حتى عام ٢٠٠٥ (المرحلة طويلة المدى) .
- أتجاهات مقترحة لشبكات مياه تستمد مياهها من نهر النيل لزراعة الوديان الشرقية .

شكل رقم (٧)

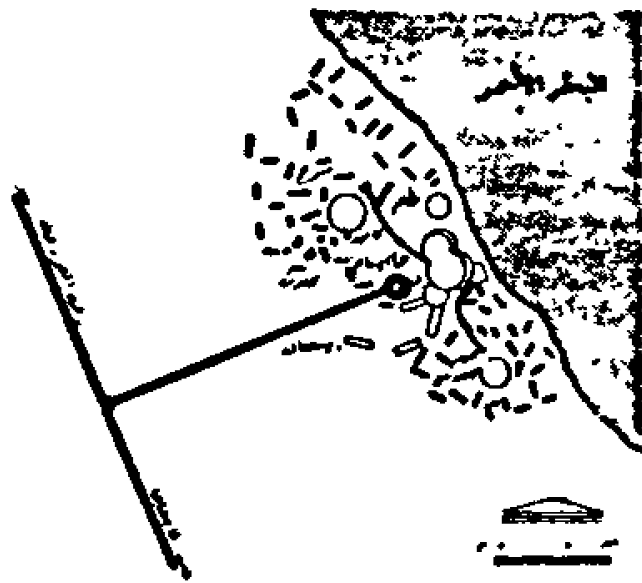


- مدينة الغردقة عاصمة الاقليم ومركز النشاط السياحى الرئيسى بالمنطقة .
- أحجام مدن وتجمعات البحر الاحمر الحالية .
- أحجام المدن الرئيسية المحيطة بأقليم البحر الاحمر .
- تجمعات عمرانية ترتفع فيها نسبة العمالة السياحية .
- تجمعات عمرانية نسبة العمالة فيها متوسطة .
- تجمعات عمرانية تكاد تنعدم فيها العمالة السياحية .
- مدن ترتفع فيها نسبة القوى البشرية القابلة للعمل والتى يمكن الاستفادة بنسبة منها كقوى عاملة سياحية .
- حدود مناطق التنمية العمرانية وتنقسم الى ثلاث مناطق (المنطقة الشمالية من رأس الزعفرانة حتى الغردقة) ، (المنطقة الوسطى حتى القصير) ، (المنطقة الجنوبية حتى حدود السودان) .
- محور التنمية العمرانية الرئيسى الساحلى .
- محاور امتدادات عمرانية متعامدة على المحور الرئيسى وتتجه نحو وادى النيل .
- اتجاهات أمتدادات عمرانية مقترحة تحقق استراتيجية التنمية العمرانية المقترحة للمنطقة .
- تجمعات عمرانية بدوية نائية ذات احجام سكانية مختلفة .
- مناطق انتشار القبائل البدوية .
- أتجاهات هجرة العمالة الموسمية (الشتوية ، الصيفية) الى مدن وتجمعات البحر الاحمر .
- مناطق ذات كثافات سكانية منخفضة بالمقارنة بالكثافة العامة بالجمهورية الا أنها اعلى كثافات البحر الاحمر .
- مناطق ذات كثافات سكانية منخفضة بالمقارنة بالكثافة العامة بالجمهورية الا أنها من الكثافات المتوسطة .
- مناطق ذات كثافات سكانية منخفضة جدا بالمقارنة بالكثافة العامة بالجمهورية وبمدن البحر الاحمر .

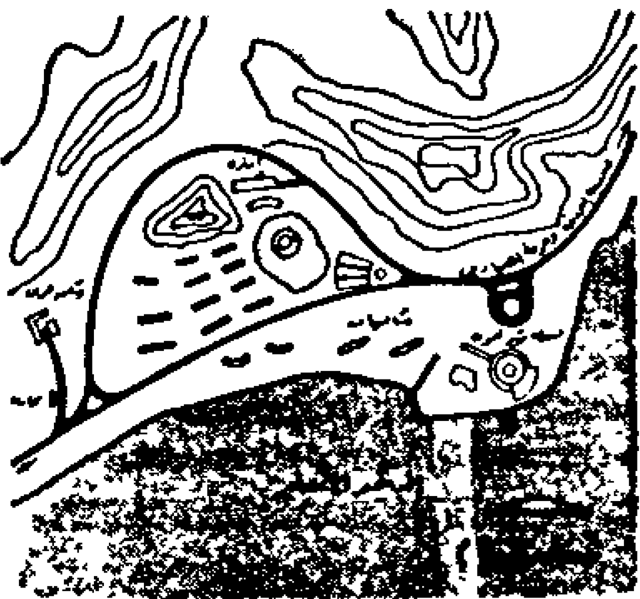
شكل رقم (٨)



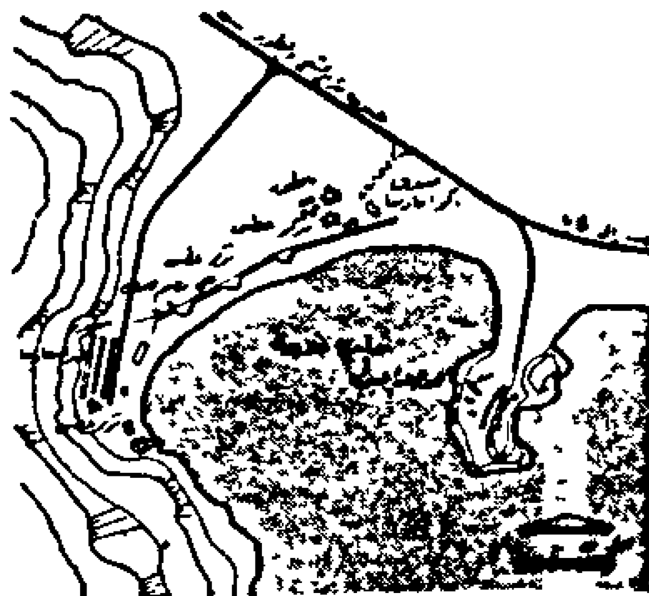
شكل رقم (٩)



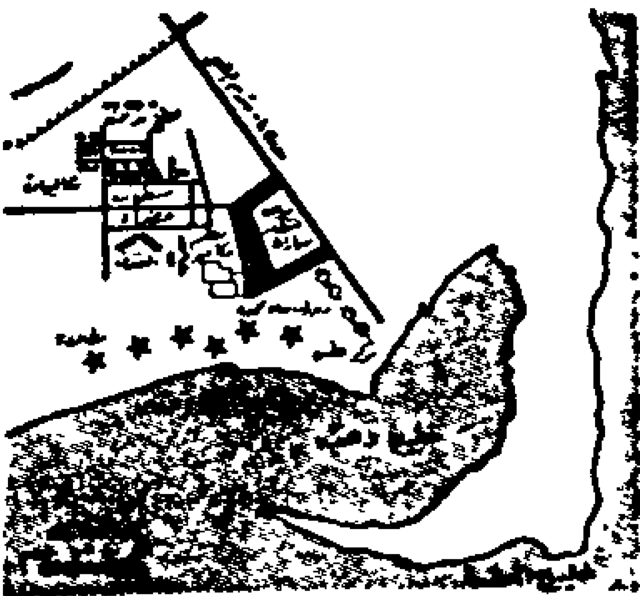
قرية مجاويش السياحية بالغردقة



منطقة شيراتون الغردقة



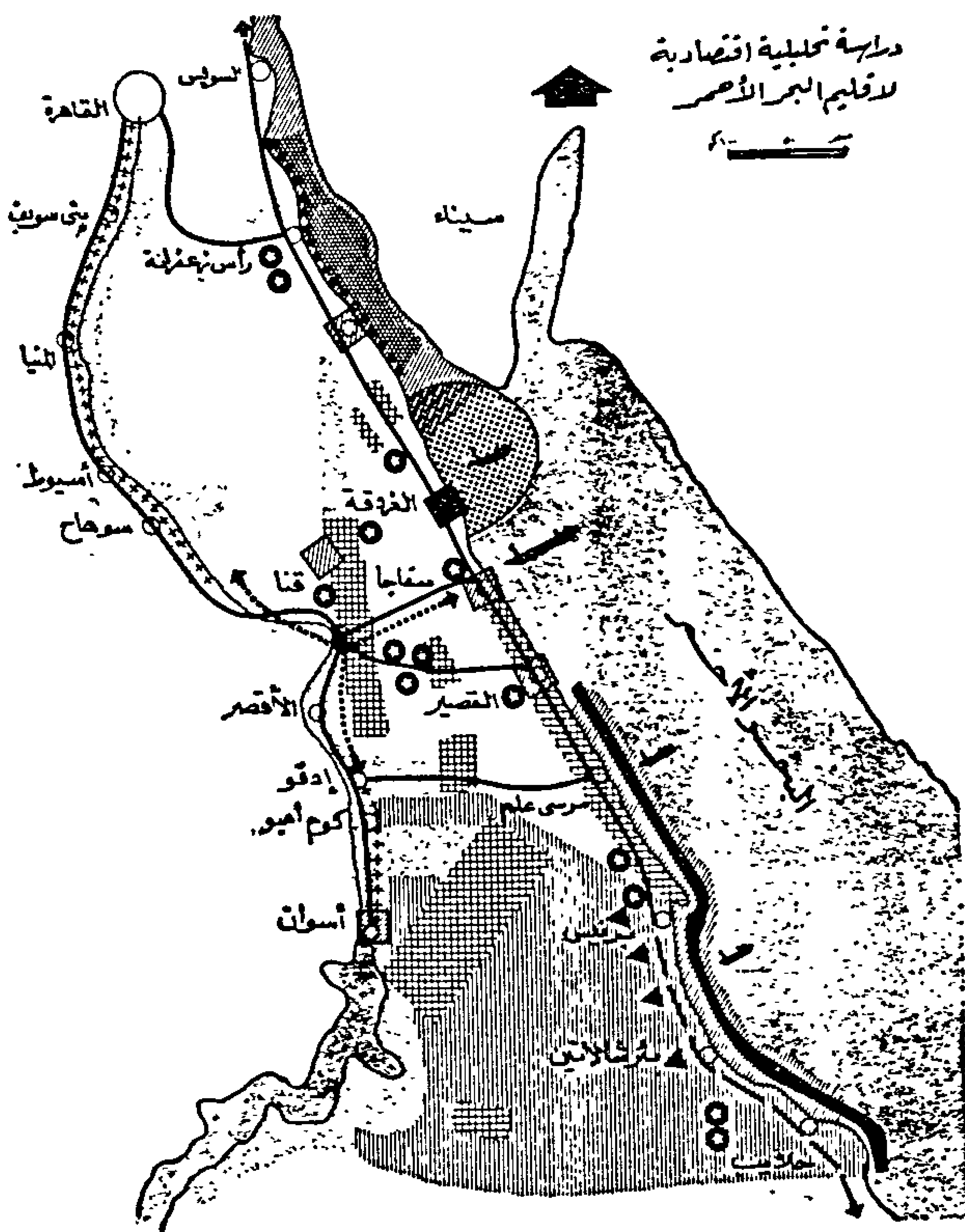
منطقة شرم الشيخ السياحية



قرية دهب السياحية بخليج العقبة

شكل رقم (١٠)

- منطقة تركز للمقومات السياحية والخدمات والعمالة السياحية يجب المحافظة عليها ووضع خطة لتنميتها كمرحلة أولى سياحيـــة .
- منطقة يمكن تنميتها من الناحية الاقتصادية كمرحلة ثانية سياحية .
- منطقة يمكن تنميتها من الناحية الاقتصادية كمرحلة ثالثة سياحية بعـــد تطهيرها من التلـــوث البترولي الموجود بخليج السويس .
- مواقع سياحية يجب المحافظة عليها مع وضع خطة لاستغلالها سياحيا ضمـــن المرحلة الاولـــى .
- مدينة الغردقة تتركز فيها الخدمات والعمالة السياحية والمزارات يجـــب تنميتها كمركز سياحي أو كنواة سياحية للمنطقـــة .
- مناطق تركيز صناعي يجب تنميتها مع وضع خطة لاستغلالها بحيث لاتتعـــارض وخطة التنمية السياحية للمنطقـــة
- مناطق تركز الاعمال التعدينية الحالية والاستكشافية يجب تقييم استغلالهـــا اما اقتصاديا أو سياحيـــا .
- أراضي ذات تربة خصبة يجب استغلالها زراعيا كمرحلة أولى لتغطي الاحتياجـــات السكانية والسياحيـــة .
- أراضي ذات تربة خصبة تتركز بالاودية وخاصة بوادي العلاقي يمكن تنميتهـــا زراعيا كمرحلة ثانية .
- اتجاهات للخروج نحو الصحراء حيث الثروات المعدنية والمراعي الخضراء .
- مواقع المزارع السمكية ومناطق الصيد يجب المحافظة عليها مع وضع خطـــة لاستغلالها بحيث تتماشى مع الاستغلال السياحي للشواطئ .
- مناطق تلوث بترولي تتركز بخليج السويس وتعتبر عائق من عوائق التنميـــة السياحية للمنطقة مابين الزعفرانة حتى رأس الريشـــة .
- شبكة الطرق الحالية تربط مابين الانشطة الاقتصادية المنتشرة على الساحـــل
- شبكـــة الطرق المقترحـــة .
- مسارات السكة الحديدية الحالية بوادي النيل تخدم حركة النقل والحركـــة السياحيـــة .
- مسارات سكة حديدية مقترحة تربط مابين وادي النيل والبحر الاحمر (سفاجـــا ـ قنـــا) نظرا لكثافة حركة النقل على هذا المحور وللاستغلال الامثل لمينـــاء سفاجا المزمع تطويـــره .
- ميناء سفاجا أهم الموانئ الشرقية للبحر الاحمر وهو ميناء صناعي يخـــدم حركة النقل والشحن الا أن وجوده لايتعارض والتنمية السياحية للمنطقة .
- مراس وموانئ صغيرة يمكن تنميتها للاستغلال السياحـــي .



شكل رقم (١١)

وفى نهاية الدراسة نستنتج من العامل الأول احجام وانماط سياحية حالية متوقعة ذات متطلبات من طاقة فندقية وعمالة سياحية مباشرة وغير مباشرة وخدماتها التكميلية من مياه ، وكهرباء وخلافه .

اما العامل الثانى فنستنتج منه مناطق سياحية حالية ومناطق أخرى يمكن استغلالها للتنمية السياحية المستقبلية ، ومواقع سياحية ساحلية تبلغ ٨٠ موقعا صنفتها وزارة السياحة الى ثلاث مستويات دولية (أ) ، (ب) ، (ج) .

وقبل أن نضع خطة تنمية المنطقة سياحيا لنتسأل هل ستوزع هذه الطاقات الفندقية المتوقعة مستقبليا على جميع المناطق الصالحة للتنمية السياحية ؟ أم ستوزع على مناطق الطلب السياحى الحالى ؟

والاجابة بالقطع سوف توزع على مناطق الطلب السياحى الحالى بنسب تتناسب طرديا مع حجم الحركة السياحية القادمة لكل منطقة على حده مع الأخذ فى الاعتبار المناطق الصالحة للاستغلال السياحى لم تستغل حتى الآن يمكن أن تظهر فى مراحل متاخرة فى خطة التنمية السياحية .

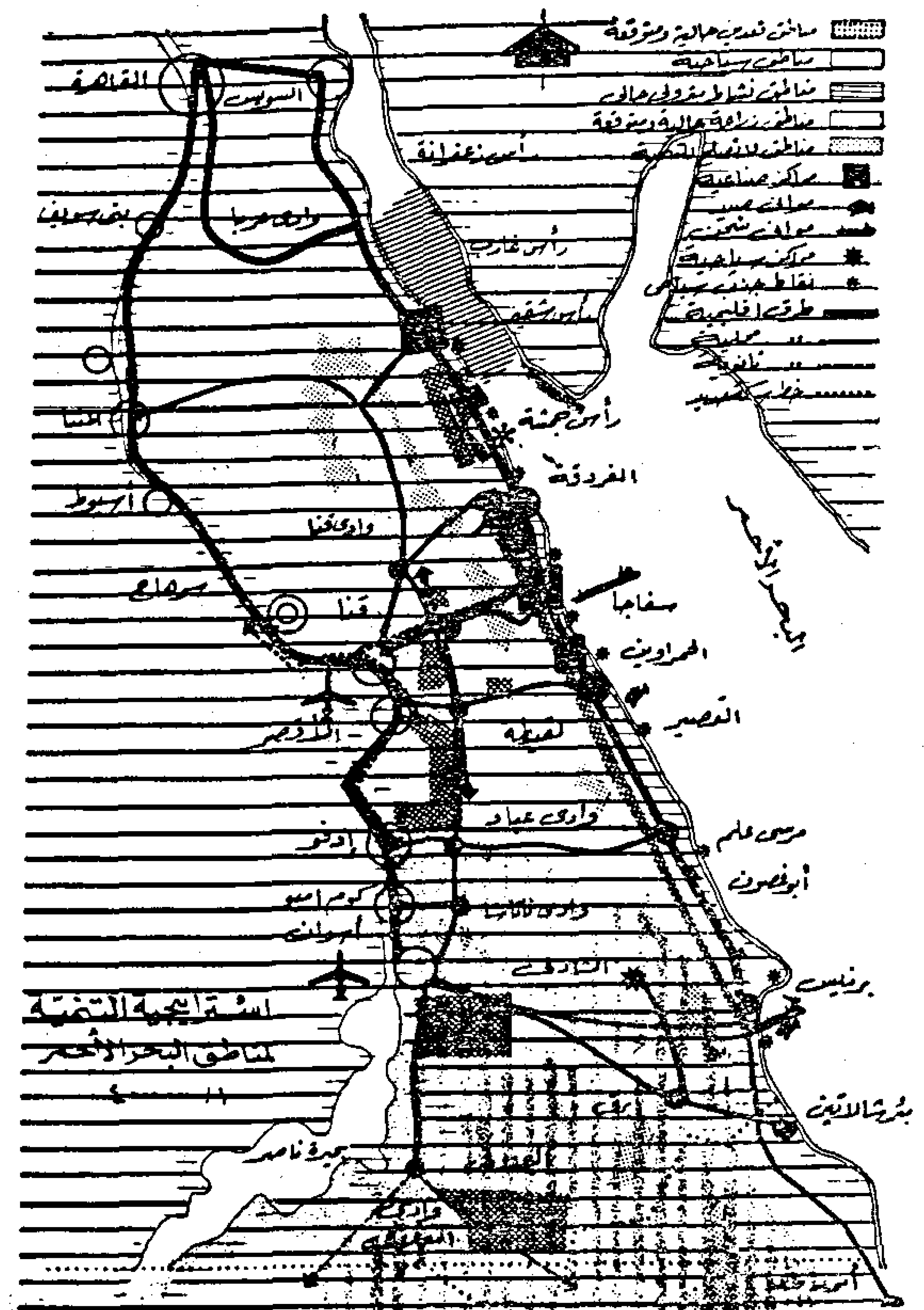
وتتم هذه الخطة مرحليا حتى سنة ٢٠٠٥ تنتهى المرحلة الأولى بنهاية عام ١٩٩٠ لتغطى الساحل من الزعفرانة شمالا حتى مرسى علم جنوبا كما يبينها الشكل رقم (١٤) ، (١٥) .

اما المرحلة الثانية فتنتهى كما وضحنا عام ٢٠٠٥ وتمتد حتى برنيس جنوبا لتغطى كافة احتياجات الطلب السياحى من سياحة خارجية وسياحة رجال الاعمال وسياحة داخلية كما يبينها الشكل رقم (١٦) .

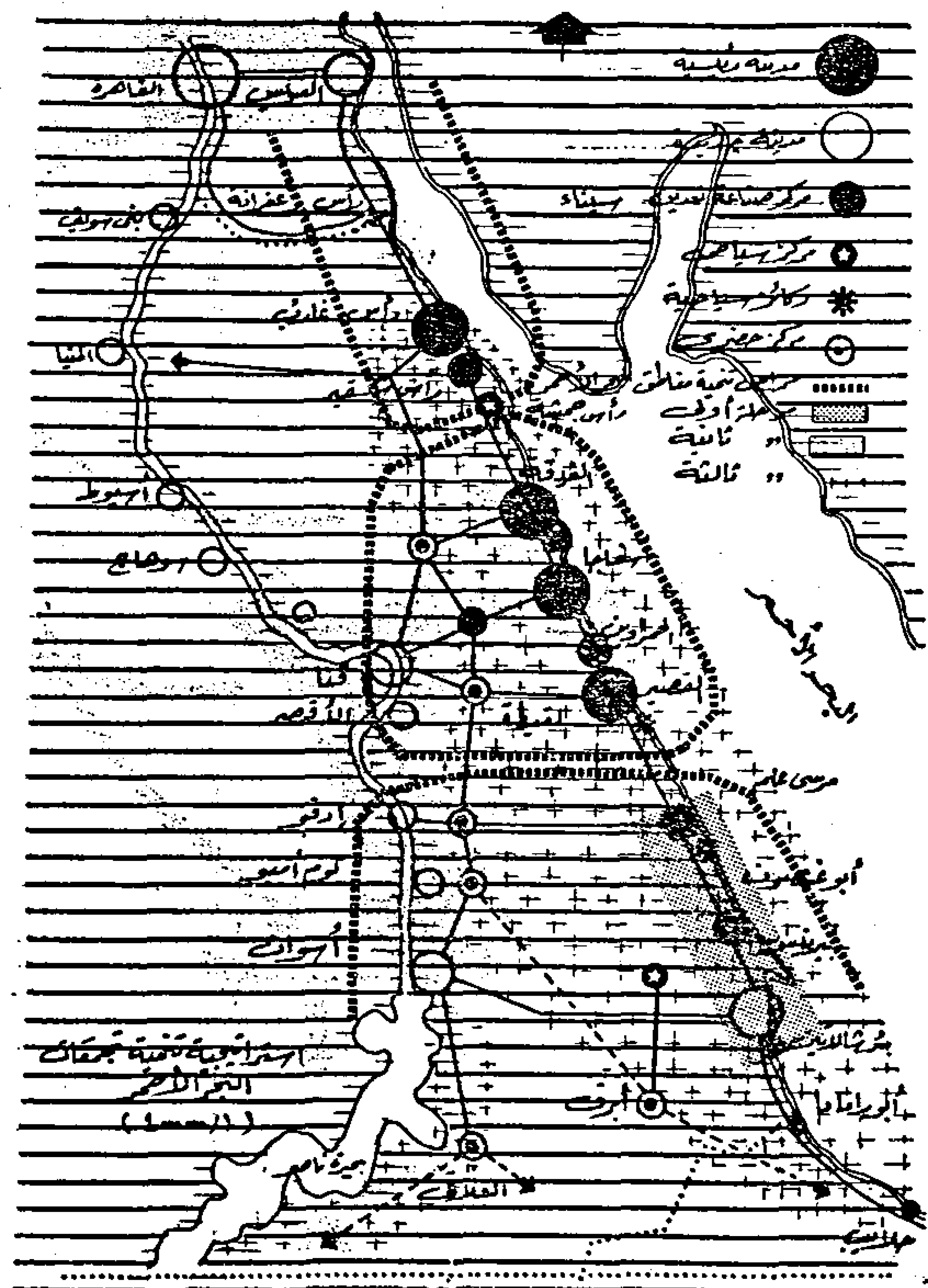
وتاتى نتائج البحث فى صورة مجموعة من التوصيات والمقترحات يمكن ان تحقق التنمية السياحية المرجوة للمنطقة .

اولا : توصيات سياحية عامة :

ـ الهدف منها ازالة كافة العقبات والعراقيل الروتينية والتى تؤدى الى نفور السائحين مع الاسراع فى تنفيذ اجراءات حجز التذاكر بشركات الطيران والفنادق والرحلات السياحية والافراج الجمركى .



شكل رقم (١٢)



شكل رقم (١٣)

خطة التنمية السياحية لإقليم البحر الأحمر
تنمية المناطق التى تخدم حركة السياحة الخارجية

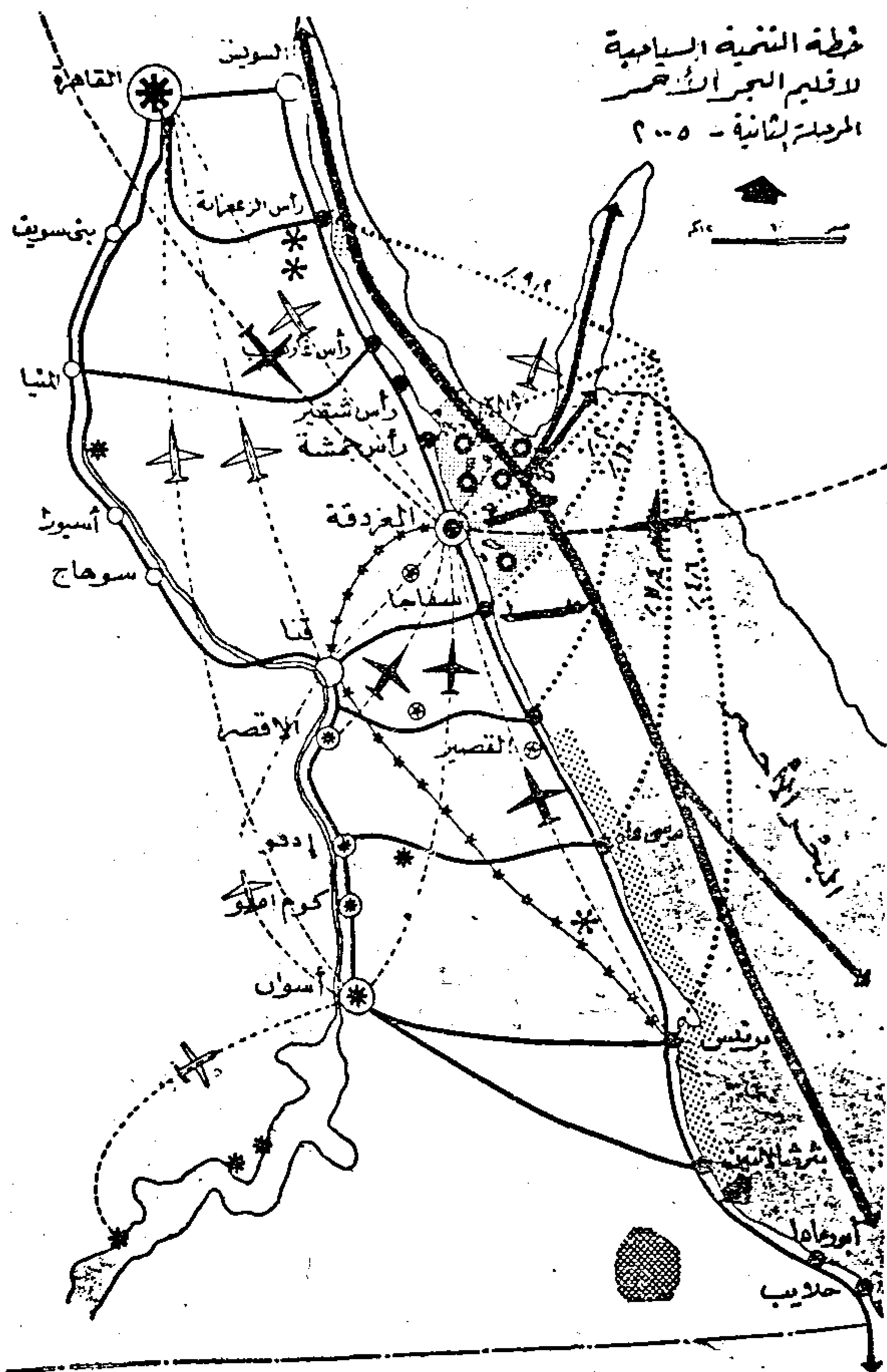
◉	مدينة الغردقة أهم مناطق الجذب السياحى بالبحر الاحمر ويجب تنميتها لتصبح مركزا سياحيا .
○	تجمعات عمرانية بها بعض الخدمات السياحية يجب الاهتمام بها والحفاظ عليها .
(منطقة منقطة)	المنطقة السياحية المقترحة لاستيعاب حركة الجذب السياحى للسياحة الخارجية والمفروض تنميتها وتوفير كافة الخدمات اللازمة لها وهى أهم المناطق السياحية الحالية .
**	مواقع الغطس وهى أهم مقومات الجذب السياحى للسياحة الخارجية الى البحر الاحمر ـ لذا يجب تنميتها وتوفير الخدمات اللازمة لها من مراسى لليخوت وأندية غطس ، مدربين ، أجهزة .
(سهم)	اتجاه الحركة السياحية .
(خط منقط)	مسارات حركة الطيران الحالية والتى تخدم السياحة .
(خط منقط)	مسارات حركة طيران مقترحة لخدمة الحركة السياحية الخارجية القادمة للاقليم .
(طائرة)	مطار الغردقة يجب تنميته وتطويره لإنتقة لاستقبال حركة الطيران الدولى .
(خط)	المسار البحرى الحالى من الشرق الى الغرب والعكس والذى يجب الاستفادة منه فى جذب الحركة السياحية الى المنطقة .
(خط متقطع)	مسار بحرى مقترح يمكن أن يخدم الحركة السياحية الخارجية .
(رمز)	ميناء بحرى يمكن أن يساهم فى خدمة الحركة السياحية القادمة بحرا بتنميته وتطويره .
(خط سميك)	الطريق الساحلى الممتد من القاهرة : السويس الى السودان يجب تنميته وتوفير الخدمات عليه واعداده لاستقطاب الحركة السياحية الخارجية القادمة الى القاهرة والحركة السياحية الافريقية .

شكل رقم (١٤)

خطة التنمية السياحية لإقليم البحر الأحمر
المرحلة الأولى ـ ١٩٩٠

●	تجمعات عمرانية رئيسية .
◉	تجمع عمرانى رئيسى (الغردقة) مقترح اقامة مركز سياحى به .
(رمز)	شبكة التوزيع المقترحة للخدمات السياحية المباشرة على المدن والتجمعات الرئيسية بالمرحلة الاولى .
(نجمة)	مناطق جذب سياحى رئيسية .
⊛	مزارات سياحية يجب الحفاظ عليها .
*	مزارات سياحية تحتاج مناطق تواجدها الى تنمية وتطوير مرافقها وخدماتها السياحية المباشرة .
(منطقة منقطة)	مناطق سياحية شاطئية بها العديد من المواقع السياحية الصالحة للاستغلال السياحى الدولى .
(منطقة منقطة)	منطقة تركز الجزر والشعاب المرجانية ومواقع الغطس (أهم المقومات السياحية بالمنطقة) .
(منطقة داكنة)	منطقة جبل علبة صالحة لرياضات الصيد والتسلق والمغامرة .
(خط)	شبكة الطرق المرصوفة الحالية تخدم الحركة السياحية والمواقع السياحية يجب توفير الخدمات عليها .
(خط)	طرق ترابية لاتحتاج الى رصف بالمرحلة الحالية .
(خط متقطع)	طرق مقترح رصفها بالمرحلة الحالية لاهميتها فى تحقيق التنمية السياحية المنشودة للمنطقة .
(خط)	طرق ترابية تتركز عليها بعض الاثار السياحية الا أنها لاتحتاج الى رصف بهذه المرحلة .
(خط)	طرق مقترح رصفها لتركز بعض الاثار السياحية عليها وأهميتها فى خطة التنمية كمرحلة أولى .
(رمز)	مسارات حركة طيران دولية مقترحة .
(رمز)	مسارات حركة الطيران الداخلية الحالية يجب الحفاظ عليها .
(رمز)	مسارات حركة طيران مقترحة لتحقيق سرعة الاتصال مابين المناطق السياحية
(طائرة)	مواقع مطارات دولية مقترحة .
(خط)	مسارات بحرية حالية يمكن أن تخدم الحركة السياحية للمنطقة .
(خط)	مسارات بحرية مقترحة تحقق الربط السياحى البحرى مابين الاقاليم السياحية واقليم البحر الاحمر .
(رمز)	مواني بحرية يمكن ان تسهم فى خطة التنمية السياحية كمرحلة أولى .

شكل رقم (١٥)



شـكل رقم (١٦)

ـ اعادة النظر فى أسعار الفنادق بما يتلائم مع الاسعار العالمية ومستوى الخدمة المتاح مع تعميم الفنادق ذات الثلاث نجوم فأقـل والتى يمكن أن تخدم معظم القاعدة السياحية والمتمثلة فى السياحة الاجتماعية .

ـ العناية بمستويات الخدمات الفندقية وبخاصة العمالة السياحية وتدريبها التدريب الذى يؤهلها من التعامـل مـع كافـة الانماط السياحية وذلك بأنشـاء المدارس والمعاهـد الفندقية المتخصصة .

ثانيا : توصيات تخطيطية :

✽ توصيات للمحافظة على البيئة والغرض منها وضـع القوانين الخاصـة بالمحافظة على الثروات الحالية مع انشاء جهاز فنى متخصص الغرض منه :

ـ مكافحة التلوث البترولى سـواء الناتج عن السفن المارة أو المنشـآت البحرية وشركات البترول الواقعـة على السـاحل مع توقيـع العقوبات عليها فى حالة مخالفتها . أو أى شكل آخر من اشـكال التلوث وبخاصـة الناتج من المصانع والمحاجر المنتشرة على الساحل .

ـ المحافظة على الشـعاب المرجانية والثروة السمكية بأنشـاء المراسى الخاصـة بالعبارات واليخوت وتحريم الصيد بالديناميت او الحراب

ـ الحفاظ على النباتات الطبيعية التى تنمو على السواحل كأشجار المانجروف والحيوانات البرية المنتشرة بالصـحارى المتاخمة .

✽ توصيات للارتقاء بالبيئة العمرانية مثـل تدعيم لشبكة الطرق الحالية وبخاصـة الجزء الجنوبى منها مع تزويدها بالخدمات اللازمـة للطرق السريعة مع التركيز على الطرق العرضية والتى تربط ميناء سـفاجا بوادى النيل وأنشاء خط سكك حديدية تؤكد هذا الربط .

ـ تجديد المراسى والموانى الساحلية لخـدمة الحركة السـياحية مع تطـوير ميناء الغردقة الجوى .

ـ تأكيد وتركيز كافة الجهود وبصورة ملحة وسريعة لمعالجة اهم عائق فى سبيل التنمية هو توفير المياه النقية وبكميات مناسبة سواء للسكان أو للسياح .

* توصيات للتنمية الاجتماعية والاقتصادية.

ـ وتنحصر فى أطار الاهتمام بالسكان وحالاتهم الصحية والتعليمية وتوفير كافة احتياجاتهم المعيشة من أسكان ومتطلبات غذائية حالية ومتوقعة هذا الى جانب توفير الخدمات اللازمة لهم سواء الصحية أو التعليمية أو الاجتماعية.. مع التركيز على المدارس الفندقية ومعاهد السياحة والفنادق لتخدم التطور السياحى المرتقب للمنطقة .

ـ الاهتمام بتوجيه الاستثمارات القومية والاقليمية لقطاع السياحة حيث أن النسبة المخصصة لخدمة قطاع السياحة ضئيلة جدا لا تتعدى ٢٪ من اجمالى الاستثمارات الاقليمية بينما قطاع كالبترول يستحوذ على أكثر من ٤٠٪ .

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أهمية المناطق الخضراء فى التخطيط

دكتور / عصمت عاشور احمد ابو العلا *

مقـــدمة :

تعتبر المناطق الخضراء هى العنصر الحيوى فى التخطيط ومستوياته القومى والاقليمى والمحلى (مدن ـ قرى) .

ونظرا لانتشار التلوث فى النصف الثانى من القرن العشرين نتيجة للزيادة السكانية الهائلة وكذلك انتشار الصناعة ، والتقدم التكنولوجى واستخدام الكيماويات والذرة فى هذا التقدم .

كل هذا ادى زيادة العمران على حساب المناطق الخضراء وخاصة فى الدول المتخلفة او النامية ، حيث ان اهتمامها الاساسى هو مواجهة الزيادة المطردة ولم يكن انتشار العمران هذا ناتج عن تخطيط مسبق ولكن بدون تخطيط .

ونظرا لاهمية المناطق الخضراء فى التخطيط سواء على المستوى الدولى غابات ومراعى ومناطق زراعية والدول التى تشترك فيهـا . والظروف القطع المستمر للغابات دون تخطيط والرعى الجائر والاراضى الزراعية بطريقة استنزافية . كل هـذا ادى الى ضرورة عمل تخطيط دولى على مستوى الغابات والمراعى والاراضى الزراعية ومثال ذلك ما حدث ى افريقيا قامت الدول بقطع الغابات الافريقية مما سبب الجفاف الجالى سواء للانهار او للارض الزراعية والرعى وبالتالى الحياة عموما .

اما المستوى القومى والاقليمى فهو هام على مستوى الدولة كتخطيط الاقاليم الزراعية والرعى والغابات والوديان وكذلك يقوم عليه الانشطة المختلفة وبالتالى المدن والقرى. واخيرا المستوى المحلى (مدن ـ قرى) وهو يجب ان يكون نابعا من تخطيط اقليمى وتنمية اقليمية للزراعة والغابات والرعى ، وكذلك دراسة كاملة عن المناطق الخضراء داخل المدن والقرى الحالية والمعدلات الحالية الموجودة ومدى انطباقها على جمهورية مصر العربية. وان نسبة المناطق الخضراء سواء حدائق او مناطق خضراء تعتبر منخفضة جدا فى المدن الحالية وتتناقص نتيجة لاعتداء السكان وامتداد العمران عليها بالاضافة الى الاعتداء على الاراضى الزراعية وكذلك معدلات ونسب المناطق الخضراء فى المدن الجديدة بجمهورية مصر العربية ومدى انخفاضها بالنسبة للمعدلات العالمية على الرغم ان معظم المدن الجديدة بجمهورية مصر العربية صناعية .

وهذا البحث يتناول أهمية المناطق الخضراء فى التخطيط وعلى مستوياته وامكانية الحافظ عليها وزيادتها للوصول الى افضل النسب والمعدلات والتى تتناسب مع بلادنا .

اولا : اهمية المناطق الخضراء على المستوى الاقليمى والقومى والدولى :

تعتبر المناطق الخضراء على المستوى الاقليمى والقومى والدولى هى العنصر المؤثر على التخطيط وفى جميع مستوياته . حيث أن لها تأثير مباشر فى المناخ : (الحرارة ـ الرطوبة ـ الامطار ـ الرياح وتحريكها ـ الضغط الجوى) وبالتالى على المدن والقرى التى تعتمد اعتمادا على المناطق الخضراء سواء فى الزراعة او الرعى وتنقية الجو ، وعلى ذلك فان المناطق الخضراء المؤثرة على التخطيط وحياةالانسان فى المستوى الاقليمى والقومى والدولى هى الغابات والمراعى والمناطق الزراعية ، وهـذا ما سنتناوله فيما يلى :

١ ـ الغابات :

تعتبر الغابات الطبيعية من اكثر الاجهزة البيئية الارضية تطورا وهى تغطى حاليا حوالى ٢٨ ٪ من مساحة القارات اى فى حدود ١٠ ٪ من مساحة الكرة الارضية .

للغابات الطبيعية خصائص هامة تجعلها ترتبط بحياة الانسان خاصة وبنمط الحياة الارضية عامة ، ولذلك فان لتدهورها او لزوالها انعكاسات خطيرة على حماية الانسان وتخطيط المدن . ولاظهار هذه العلاقة المتبادلة بين الغابات الطبيعية وتخطيط المدن والقرى سوف نبين باختصار خصائص الغابات :

* مدرس / بقسم التخطيط ـ كلية الهندسة / جامعة الأزهر

أ ـ تعتبر الغابات من المصانع الطبيعية الضخمة التى تقوم بواسطة عملية البناء الضوئى بتحويل القدرة الشمسية الى قدرة كيميائية عن طريق امتصاص غاز ثانى اكسيد الكربون واطلاق الاكسيجين .

تبين تقارير منظمة التغذية والزراعة العالمية ان الغابات تبث سنويا اربعين مليار طن من الكربون وان هذه القدرة المنتجة والمدخرة تستهلكها كافة الحيوانات عن طريق السلاسل الغذائية الموجودة ضمن الغابات .

ان وجودنا مرتبط بالنباتات الخضراء التى تقوم بواسطة البناء الضوئى بعملية عظيمة جدا وهى تحويل المواد غير الحية الى مادة حية بينما تكتفى بقية الكائنات الحية الحيوانية بتحويل المادة الحيه (غذاءها) التى كونتها الأوراق الخضراء الى مادة حية اخرى لبناء جسمها . فالغابة تقوم اذا بصنع ما لا تستطيع أية صناعة صنعة وهو الحياة .

تنتج الغابات ٤٥٪ من الانتاج الكلى للمادة العضوية على الارض وثلاثة ارباع الانتاج العضوى للاراضى غير المغمورة . ان مردود الغابات عال نسبيا اذا قورن بالمراعى أو بالمحاصيل الزراعية ، ان ٠٫٣٣٪ من القدرة الشمسية التى تحصل عليها الغابات تتحول الى مادة عضوية مقابل ٠٫١٠٪ للمراعى و ٠٫٢٥٪ للمحاصيل الزراعية من السبعمائة مليار طن من الكربون الموجود فى الجو الارضى بشكل غاز الكربون ، فان غابات الكرة الارضية تبث فى كل عام من عشرين الى اربعين مليار طن . هذا وان غابة متوازنة فى البلاد ذات المناخ المعتدل تنتج من واحد طن الى ثلاثة اطنان من الاكسجين فى الكيلو متر المربع فى اليوم ، اى اربعة الى عشرة اطنان فى الهكتار فى السنة ، وهذا يشكل ضعف ما ينتجه هكتار من المراعى .

ان البلانكتون النباتى (الطافيات النباتية)٧ فى المحيطات لا ينتج اكثر من نصف طن اكسجين فى اليوم وفى الكيلو متر المربع لا احد يجهل اهمية الاكسجين بالنسبة للانسان وللحيوانات وتخطيط المدن والقرى وهذا مايفسر لنا مدى ارتباط الحياة الانسانية بوجود الغابات الطبيعية وبسلامتها .

(ب) للغابات تأثير واضح فى المناخ والحقيقة يوجد مناخ خاص داخل الغابات ، فهو اكثر اعتدالا من الناحية الحرارية واكثر رطوبة واشد انتظاما من مناخ المناطق الخالية من الغابات ، وهو بهذه الخاصة يسهل حياة الكائنات الحية الحيوانية والنباتية والتى تلتجىء ، اليه ، هذا وأن الغابة تخفف الى حد كبير من حدة الرياح كما تساهم فى ارتفاع قيمة الرطوبة الجوية بشكل محسوس . أن الغابات المتسعة الارجاء تزيد من الامطار الهاطلة نتيجة للكميات الكبيرة من بخار الماء التى تطرحها فى الجو من جهة وبسبب انخفاض درجة الحرارة فوق الغابات والناتج عن شدة امتصاص القدرة الحرارية الضرورية لتبخر ونتح المجموع الورقى فى البلاد المعتدلة مثل البلاد الخاضعة للمناخ المتوسطى كجزء كبير من العالم العربى ، فان هكتارا من الغابات يمكن ان يبخر كمية من الماء تتراوح بين ١٥٠ مم (١٥٠٠ م٣) الى ٤٠٠ مم (٤٠٠٠ م٣) فى السنة حسب نوع الغابة (اليفة الجفاف أو اليفة الرطوبة) . ان الأرقام هى اعلى من ذلك بكثيربالنسبة للغابات الاستوائية٧.

(جـ) للغابات تأثير واضح فى تكوين التربة وفى المحافظة عليها وعلى خصوبتها بنفس الوقت ، اذا ان الاشجار والنباتات الأخرى المكونة لها تحميها من اشعة الشمس مما يجعلها تحافظ على التربة ومن حدة سقوط الامطار على الأرض مما يخفف الى حد كبير من انجراف التربة وخاصة فى البلاد المتوسطية التى تسقط امطارها بشكل رخات قوية ، كما ان جذور الاشجار تساهم فى تثبيت التربة وتجعلها اكثر مقاومة للانجراف المطرى او الراحى . أن العنصر الناتج عن تحول البقايا النباتية يحسن من بنية التربة فى الغابة وبالتالى يرفع من نفاذيتها لمياه الامطار ويجعلها اكثر مقاومة للانجراف .

يوجد داخل الغابة دورة للعناصر المعدنية الغذائية تسمح للغابات المتوازنة له بيولوجيا ان تحافظ على استمرار خصوبتها . والحقيقة ان البقايا النباتية المتراكمة فوق سطح التربة تتحول تحت تأثير الكائنات الدقيقة فتحرر منها العناصر المعدنية التى تمتصها جذور الاشجار فتساعدها على بناء جسمها لتنمو ، ثم تعود هذه العناصر من جديد الى التربة عن طريق الأوراق والاغصان الميتة وهكذا .

(د) تخفف الغابة من الانسيال السطحى لمياه الامطار الى حد كبير وهى بهذه الخاصة تحارب السيول والفيضانات وتؤمن انتظام تدفق مياه الينابيع والأنهار . كما انها تسهل تسرب المياه داخل التربة ومنها لتغذية المياه الباطنية لما تحتويه من بقايا نباتية على سطح التربة ولحسن نفاذية التربة نفسها . فالغابة تلعب اذن دورا كبيرا فى المياه ويظهر هذا الدور اهمية بالغة فى البلاد المدارية التى تتميز بتوالى فترات غزيرة

الامطار وفترات شـديدة الجفاف وكذلك فى البلاد ذات المناخ المتوسطى حيث تتركز الامطار فى الفصول الباردة والباردة نسبيا بينما يكون الصيف جافا ، علما بان هـذه الامطـار تنهمر بشكل رخات قوية .

ومن المعـروف ان الينابيع هى اكثر غزارة واكثر نقاوة وذات تدفق أكثر انتظاما فى المناطق الحراجية . ان هذا الدور المنظم للمياه الذى تقوم به الغابات هو من أهم خواصها ويظهر لنا شدة ارتباط الغابة بحياة الانسان وبالمحافظة على انتاجية البيئة وسلامتها . ان ازالة الغابات وخاصة على المنحدرات لزراعة محاصيل اخرى دون اخذ الاحتياطات اللازمة بانشـاء المدارج تؤدى الى تنشيط الانسيال السطحى على حساب تسرب المياه داخل الاراضى مما يؤدى الى تخفيف تغذية المياه الباطنية الى حد كبير ، وهـذا ما يعرض توجه المنطقة نحو الجفاف .

(هـ) تلعب الغابة ايضا دور مصفاة طبيعية للغبار وثانى أوكسيد الكبريت والدخان وغيرها من ملوثات الجو وتساهم هكذا فى تنقية الجـو سواء للمدن أو القـرى وجميع الصناعات بأنواعهـا .

ان غابة من الاشجار ذات الأوراق العريضة فى البلاد المعتدلة يمكن ان توقف سنويا بحدود ٨٠ طنا من الغبـار فى الهكتار وغـابة من الصنوبريات ٣٠ طنا . كذلك فان هتكارا من الغابا يستطيع ان ينقى من غاز ثانى اكسـيد الكبريت هـواء يسـير ببطء ويحتوى مائة ميكروجرام من ثانى اكسـيد الكبريت . فى المناطق الحراجية يتنفس الانسان هواء يحتوى على غبار ودخان وملوثات اخـرى اقل بكثير مما هو فى المناطق الخالية من الغابات ، وتبدو هذه الخاصة للغابة فى تنقية الهواء ذات اهمية بالغة فى المدن المجاورة للمصانع الملوثة الهـواء وذلك بالاضافة الى اغناء الجو بالاكسجين الناتج عن البناء الضـوئى فالغـابة اذا جهـاز بيئى صحى جدا للانسان . هذا مما يجدر ذكره هنا ان دور التنقية ينطبق ايضا على الضجيج وقد بينت الدراسـات ان حاجزا حراجيا يمكن ان يخفف الضجيج بحدود (١٠ د . ب) لكل متر من سماكة الحاجز الحراجى .

(و) ان الغابة مصدر للاخشاب ولمواد اخرى تلعب دورا هاما فى الحياة المعاصرة ازداد استهلاك الاخشاب بحدود ٣٨٪ بين عامى ١٩٥٠ ، ١٩٦٠ ويعتقد ان هذه الزيادة أصبحت بحدود ٢٠٪ كل عشر سنين .

ان الغابات الحالية عاجزة عن تامين هـذه الحاجة المتزايدة خاصـة اذا تتابع انخفاض رقعتهـا .

ان القطع الجائر للغابات وخاصة على الاراضى المنحدرة يولد انجرافا متسارعا للتربة وضـياعا كبيرا لمياه الامطار وهذا من الأسباب الرئيسـية فى الجفاف فى افريقيا حاليا .

وعلى هذا يتضح لنا اهمية الغابات فى تخطيط المدن والقـرى والاقاليم ومستقبل حيـاة الانسان .

٢ ــ المـراعى :

ان الادارة البيئية المراعى البيعية تؤدى الى تدهور النبت الطبيعى الذى يرافقه دوما تدهور فى التربة والمناخ ، واذا تتابع التدهور تتعرى التربة وتصبح عندئذ عرضه للانجراف الشديد بواسطة مياه الامطار والرياح وفى النهاية تتحول هذه المـراعى الى اراض قاحلة عاجـزة عن امتصاص مياه الامطار لتغذية المياه الجوفية ، كما ان الاتربة تصبح جافة جـدا وخاصة على المنحدرات لعجزها عن امتصاص مياه الامطار . وهذا يقضى على المدن والقرى القائمة على الرعى

انالامثلة علىتدهور المراعىالطبيعية فى العالم عامة وفى الوطن العربى خاصـة عديدة . ان البادية السورية هى أحسن مثال على هـذا التدهور الهائل للنبت الطبيعى تحت تأثير اسنان الحيوانات الناتج عن تفهم خاطىء لعلاقة الانسان والحيوان بالنبت الطبيعى وعن مدى تحمـل هذا النبت التأثيرات المفروضة عليه والمناقضـة للقوانين المنظمة للاجهـزة البيئية . ان البادية السـورية هى اوضح مثال على تهديم الانسـان بادارته اللاواعية وبعـدم معرفته لعمل الأجهزة البيئية للبيئة الطبيعية.انتقلت البادية السورية خلال عدة قرون من الاستثمار السيء من منطقة مغطاه بنبت طبيعى متوازن مع البيئة (المنـاخ والتربة) وقادر على تجديد نفسه باستمرار الى منطقة متدهورة بنبتها وبتربتها وبمياهها .

ان اعادة التوازن الى البادية امر صعب للغاية فى الوقت الحاضر ويتطلب وضـع سـياسة تخطيطية تطبق بدقة وخلال فترة طويلة جـدا من الزمن .

ان تهديم الاجهزة البيئية سهل اما اصـلاح التهديم فهو أمر صعب للغاية واحيانا مستحيل ان مثل هذا التدهور واضـح فى كافة مناطق المراعى المتوسـطيه والمداريه (السـودان) فى العالم٧ العربى وفيرة فى بلاد العالم .

٣ ـ الزراعـــة :

لتلبية متطلبات سكان المدن والقرى من الغذاء والصناعة والسكن قام الانسان خلال العصور السالفة بتحويل الغابات الطبيعية الى اراضى زراعية فاستعاض إذن عن الأجهـــزة البيئية الطبيعية بأجهزة اصطناعية هى الأراضى المزروعة بمحاصيل متنوعة بعد تحوير البيئة والتى نميل ان نطلق عليها اسم الاجهزة الزراعية .

استعاض الانسان عن السلاسل الغذائية وعن العلاقات المتبادلة بين الكائنات الحية النباتيـــة والحيوانية والمواد الغير حيـــة المميزة للاجهزة البيئية الطبيعية بنمط آخـــر من العلاقات بين المحصول المزروع والبيئة المحيطة به بعد اجراء تحويرات شديدة فى هذه البيئة بهدف الحصول على مردود عال من هذا المحصول .

كما استفاد الانسان من التكنولوجيا المعاصرة وسخرها للزراعة فاســـتعمل الآلات الحديثة والاســـمدة الكيميائية والمبيـــدات الفطـــرية والحشرية للوصول الى هـــذا الهدف . الا انه بعد مرور فترة زمنية قصيرة نسبيا ابتدانا نشعر ان هذه الأجهزة الزراعية لم تعط النتائج المرجوة منها وأخذت تتدهور ، فانهارت خصوبة الاتربة وأصبحت معرضـــــة فى الحالات القصوى الى الزوال . ان السبب الرئيسى فى هذا التدنى فى خصوبة الاتربة وبالتالى فى المردود هـــو تجاهل الانسان للقوانين المنظمة للطبيعة والمبادىء التى تعتمد عليها المحافظة على توازن البيئـــة والتى ترتبط بها انتاجيتها وانتاجهـــا للمحاصـــيل الزراعية المختلفة . ان اكبر خطأ ارتكبه الانسان فى تفهمه لاستثمار الأرض زراعيا هـــو اعتقاده بانه يستطيع استبدال العلاقات الطبيعية المعقدة الموجودة بين العوامل البيئية والنباتات بعوامل اصطناعية مبســـطة معارضا بذلك القـــوانين المنظمة للطبيعة وهذا ما جعل الأجهزة الزراعية مرهقة وسريعة العطب . كم من الاتربة فى العالم عامة وفى الوطن العربى خاصـــــة قد تدهورت خصوبتها وخف انتاجها ؟ . وكم منها ترك نهائيا لانهيار خصوبته وذلك بالرغم من تطبيق الوسائل التكنولوجية المعاصرة مثـــل اســـتعمال الآلات الحديثة والتسميد الكيميائى والمبيدات الفطرية والحشرية .

والمحافظـــة على الأراضى المزروعـــة وعلى خصـــــوبتها وانتاجيتها يجب ان نحافظ على توازنها ولما كان هذا الجهاز الزراعى هو جهاز اصطنـــاعى ، فان كافة العمليـــات التى يطبقها الانسان على هذا الجهاز يجب أن لا تزيد من قلة استقرار هذا التوازن ، أى يجب ان تكون هذه العمليات منسجمة مع العمليات المنظمة للاجهزة البيئية الطبيعية أى علينا ان ننتخب العمليات المثلى التى تسمح لنا بزيادة الانتاج الزراعى نوعا وكما (وهذا هو الهدف الرئيسى من الزراعة) مع المحافظة على اســـتمرار انتاجية الجهـــــاز الزراعى وهـــذا مرتبط بالمحافظة على خصوبة الاتربة كى تحافظ التربة على خصـــوبتها فانه يجب أن يكون هناك توازن بين خسارتها للعناصر الغذائية بسبب التغذية النباتية وانغسال التربة وعمليات الصرف) وبين محتوياتها الأصلية من هذه العناصر ، والعناصر التى يمكن ان تتكون فيها من جـــديد نتيجة تآكل المعـــادن المكونة للصخور ، وبالاضـــافة الى ذلك فانه يجب ان لا يحدث أى تدهور فى الصفات الفيزيائية للتربة (تهدم وانخفاض فى النفاذية والتهـــوية) وان لا تنخفض نسبة المادة العضوية وان لا يحـــدث جرف للطبقات العلوية الغنية بالدبال وبالكائنات الحية او تجمع أملاح سامة ومواد سامة يمكن ان تؤذى الكائنات الحية فى التربة أو أى حادث يمكن ان يؤدى الى زيادة كبيرة فى حامضـــــية أو قاوية التربة .

ان المحافظة على خصوبة الاتربة الزراعيـــة تتطلب اذن تفهم خـــاص للعمليات الزراعـــــة وللتسميد العضوى والمعدنى من حيث النـــوع والكم والمكافحة الآفات الزراعية وحماية الأرض الزراعية من الامتداد العمرانى والصناعى .

من تحلل الدراسات السابقة عن أهميـــــة الغابات والمراعى والأراضى الزراعية فى التخطيط على المســـتوى الاقليمى والقـــومى والدولى نجـــد ما يلى : ـ

أ ـ على المستوى الدولى :

ان الغابات والمراعى والأراضى الزراعية تربط الدول بعضها البعض ولذلك يجب عمل سياسة تخطيطية على المستوى الدولى سواء فى الحفاظ على الغابات لأهميتها فى التخطيط على المستوى الدولى حيث انها الحمـــاية الرئيسية للدولة سواء من التلوث او المناخ المناسب أو المصفاة الرئيسية من الغبار كمصدات للرياح والكوارث وعلى ذلك يجب التنسيق والتخطيط بين الدول التى تقع على هـــذه الغابات وربط الجميع بسياسة تخطيطية ثابتة وسن القوانين الرادعة للقطع الجائر والمستمر على الغابات . هـــذا بالاضافة لحماية الأرض من الرعى الجائر الغير منظم . معنى ذلك ان الرعى يجب ان يكون على شكل دورات منسقة للارض وتنظيم بين الدول الواقعـــة على المراعى الدولية وكذلك الأراضى الزراعية وأهميتها حيث توجد مناطق شاسعة

صالحة للزراعة وتكون مناسبة لجميع انواع المحاصيل وأيضا يجب التنسيق بين الدول الواقعة على هذه الأراضى .

٢ ـ على المستوى القـومى :

حماية الغابات والأراضى الزراعية والمراعى على المستوى القومى أى على مستوى الدولة ويجب عمل تخطيط اقليمى يشمل أهمية نوع هذه الغابات وانشاء المدن والقرى المناسبة لعدد السكان حسب نوع النشاط الاقتصادى سواء قطع اشجار الاخشاب أو رعى أو زراعة ونوعيتها وهذا لا يتأتى الا بعد تقسيم الدولة إلى اقاليم تخطيطية .

٣ ـ على المستوى الاقليمى :

بعد التوصل الى الاقاليم المناسبة سواء للغابات أو الأراضى الزراعية أو المراعى ضرورة تخطيط المدن والقرى اللازمة لهذه الانشطة سواء مدن مركزية لخدمة المدن الأخرى أو مدن صغيرة التى تقوم على النشاط الزراعى أو الرعى أو الغابات وذلك للاستفادة من المناطق الخضراء سواء اقتصاديا أو اجتماعيا أو بيئيا أو طبيعيا

اهمية المناطق الخضراء على المستوى المحـلى (مدن ـ قرى) :

تعتبر المناطق الخضراء بالنسبة المستوى المحلى سواء مدن أو قرى من أهم عناصر مكونات المدينة . ومن العناصر الرئيسية والحيوية فى تخطيط المدن والقرى حيث ان المناطق الخضراء والمفتوحة تعمل على تنقية الهواء من الغبار والأبخرة والأكاسيد العالقة والمخلفات العديدة كما يسميها بعض المخططين بأنها مناطق التنقية الصحية للمدن والقرى .

وللمناطق الخضراء تأثير مباشر على الحماية من عوامل المناخ وتلطيف الجو وخاصة فى مدن وقرى المناطق الحـارة حيث ان النبات تأثير فسيولوجى وبيولوجى باعتبار ان له خصائص جيوية بالنسبة لدرجات الحرارة المختلفة كما ان له تأثير فى امتصاص الحرارة وعدم اشعاعها علاوة على فائدة التشجير فى توفير الظلال التى تحمى شوارع المدن ومبانيها من أشعة الشمس الزائدة وقد ثبت ان درجات الحرارة للمناطق الخضراء المحيطة بالمدينة تقل بحوالى ١٠ درجات مئوية عنها داخل المدن .

وتعمل المناطق الخضراء على تخفيف الرطوبة داخل المدن والقرى وخاصة المـدن الساحلية وذلك فى المساعدة على تحريك الهواء وانخفاض جزاء من الرطوبة الزائدة عن طـريق الأوراق وتخفيف التأثير الخانق لدرجات الرطوبة العالية فى نفس الوقت التى تساعد كثيرا على تخفيف الجفاف للمناطق الجافة والصحراوية وزيادة الرطوبة النسبية وذلك من تبخر بعض الميـاه الناتجة عن عمليات الرى والتمثيل الضوئى .

ويمكن تقسيم المناطق الخضراء فى المدينـة الى مايلى :ـ

١ ـ مناطـق خضراء عامة تمتلكها الدولة وتخضع فى ادارتها لاشراف الدولة وهذه يمكن تواجدها فى الأشكال الآتية :

(أ) مساحات شاسعة من المناطق الخضراء والحشائش والزهور والنباتات وهـذه المناطق يمكن اتصالها بالاحزمة الخضراء المحيطة بالمدن سواء كانت هذه القطاعات المحيطة فى شـكل غابات او مناطق زراعية .

(ب) مناطق خضراء صـغيرة مثـل مناطق الاسترخاء المزودة بالمقاعد ومناطق للالعـاب المحدودة .

(جـ) المساحات الخضراء التى تلحق بالمدارس والمستشفيات وبيوت المسنين والعجزة وحضانات الأطفال والمبانى العامة والمناطق الرياضية حيث يمكن ان تخدم هذه المناطق العديد من سكان المدينة ترفيهيا .

(د) الحدائق العامة (منتظمة وغير منتظمة حدائق الحيوان ـ حدائق النباتات ـ حـدائق العـلاج الطبيعى أو الاسـتشفاء ـ حدائق القصور .. الخ

٢ ـ مناطق خضراء ذات ملكية خاصة لأفراد او هيئات الا انها مفتوحة للجميع (عامة) مثل المناطق الرياضية والأندية والاتحادات الرياضية، المناطق الملحقـة بكل من المدارس الخاصـة والمساجد والمستشفيات الخاصـة وحضانات الأطفال الخاصة طالما تؤدى هذه المناطق الخضراء خدمة ترفيهية للسكان وهذه ذات ملكية خاصة لأفراد محدودين يقتصر استعمالها عليهم فقط .

٣ ـ مناطق خضراء عامة : مثل حدائق المنازل الخاصة ، المناطق الخضراء لمنطقة سكنية ذات ملكية خاصة ، حـدائق البلكونات والعمارات وهذه تخدم السكان ترفيهيا .

٤ ـ مناطق الغابات : وتكون عادة فى شـكل مناطق كثيفة حـول المدينة وفى اقليمها ويمكن ان تلعب دورا كبيرا فى تشـكيل اقليم المدينـة

وتوابعها وضواحيها . يمكن تشبيه هذه الغابات المحيطة بالمدينة بالمناطق الزراعية حول كثير من المدن المصرية .

المساحات المطلوبة للمناطق الخضراء :

يمكن اعتبار هذه المعدلات بمثابة متوسطات عامة وهى تعطى مؤشرا عن المعدلات الأوروبية وكيفية حسابها وتوزيعها فى اى مشروع تخطيطى ويمكن الاسترشاد بها فى دراستنا عند حساب المسطحات الخضراء وهى كما يلى :

(أ) ملاعب الأطفال حتى ٦ سنوات من العمر
١ م٢ / ساكن

(ب) ملاعب رياضية ــ حمامات سباحة
١٣م٢ / ساكن

(جـ) حدائق صغيرة ١٠م٢ / ساكن

(د) حدائق عامة ١٦م٢ / ساكن

ولا يمكن القول عامة بأن هذه المناطق تصلح كمعدلات فى بلادنا ، فكما سبق انه يمكن الاسترشاد بها ، فعلى سبيل المثال يمكن تقليل ملاعب الاطفال الى ٥٠ سم وعلى العموم لو كان لدينا تجمعا سكنيا قدره ٨٠٠٠ نسمة (مجاورة سكنية مثلا) فان المساحة المطلوبة كمناطق خضراء تبعا للمعدلات السابقة يكون فى حدود ٨٠٠٠×٤٠م٢ = ٣٢٠٠٠٠م٢ = ٣٢ هكتارا = ٧٦ فدانا

الطرق المختلفة لتوزيع المناطق الخضراء فى المدينة

هناك طرق عديدة لتوزيع المناطق الخضراء فى المدن تخضع فى كثير من الاحوال لشكل او نموذج المدينة (Concept) ومن اشهر هذه الطرق ما يلى :

١ ــ ان تتوزع المناطق الخضراء فى شكل مساحات صغيرة متناثرة على كافة اجزاء المدينة بحيث تكون فى نطاق مسافة معقولة سيرا على الأقدام للسكان اى على مسافات قصيرة وسهلة الوصول اليها بدون عائق (شوارع سريعة ــ مرتفعات ... الخ) ومن عيوب هذه الطريقة ان تلك المناطق الخضراء المتناثرة (Dispersed) تقع على محاور المرور والمواصلات وتتخلل الكثير من المبانى العالية والشاهقة مما يفقدها اهميتها

٢ ــ ان تتوزع المناطق فى شكل حلقات دائرية حول المدينة (Green Rings) وهنا يمكن ان تعمل هذه المناطق على تنقية الجو والهواء حول البيئة السكنية خاصة (Filter) وكما يطلق عليها بعض المخططين انها تعمل كمصفاة ومن عيوب هذه الطريقة انها تحد نوعا ما من نمو المدينة الذى لابد منه بالاضافة الى ان ذلك النمو يكون عادة على حساب تلك المناطق الخضراء الدائرية كما .

٣ ــ ان تتوزع تلك المناطق الخضراء فى شكل قطاعات تشع من مركز المدينة متجهة نحو محيطها الخارجى فى شكل أصابع (Green Finger) وترتبط بالمناطق الخضراء أو الغابات او الزراعة المحيطة بالمدينة فى شكل نموذج متكامل ومن مزايا هذه الطريقة انها تعمل على اعطاء كل تجمع سكنى محصور بين أصبعين اخضرين طابعا خاصا من خلال فصلها بين هذه التجمعات ، ويمكن ان تلعب هذه المناطق دورا رئيسيا عند توزيع النقل والمرور لاسيما مع النظام المركزى حيث تستغل كمسارات رئيسية للمرور بعيدا عن الكتلة العمرانية التى يجب حمايتها منه وحفاظا على المنطقة السكنية .

٤ ــ يمكن ان تتوزع المناطق الخضراء فى شكل اصابع خضراء (Green Finger) وفى شكل حلقات دائرية خضراء أيضا (Green Ring) اى ان النظامين (ب ، جـ) يمكن مزجهما معا فى شكل نموذج واحد مع مراعاة امكانية ربط هذه المناطق بالبيئة المحيطة .

الحزام (الشريط) الأخضر : (The Green Belt)

عندما تحاط المدينة بمساحة خضراء واسعة وبعرض كاف يضم العديد من الأنشطة الترفيهية كحزام محيط للمدينة فانه يطلق عليه الحزام او الشريط الأخضر ولقد نشأت هذه الفكرة اصلا فى انجلترا وتطورت فى كثير من المدن العالمية سواء فى الفكر التخطيطى لها أو فى الواقع ، كما تطور استعمال هذا الشريط من مجرد حزام اخضر حول المدن الى منطقة تضم العديد من الأنشطة الرياضية الترفيهيةوالعلاجية والثقافية احيانا ، علاوة على ان هذا الشريط يغلف المدينة بحزام واق من انشطة غير مرغوب فيها أو استعمالات الاراضى غير محببة Objectional كما يمكن استغلال ذلك الشريط الأخضر لتقييد النمو العمرانى للمدينة فيما حولها اى انه بذلك يحمى المدينة من استعمالات خارجة غير مرغوب فيها ، كما يحمى المدينة من نمو مفرط غير مخطط له ، فاذا اضفنا الي ذلك ما تمثله تلك

المساحة الشاسعة من الخضرة حول المدينة من الناحيتين الصحية وتنقية الهواء فى البيئة الحضرية لادركنا اهمية ذلك السياج الطبيعى ، خاصة عندما تقع المدينة فى اقليم صناعى ، او فى مناطق ذات تلوث بيئى .

واذا كانت جذور هذه الفكرة نبتت اصلا فى انجلترا لمنع المدن خاصة الصغيرة من الذوبان فى المدن الأم، كما فى نظرية هوارد(E. Howard) عن المدن الحدائقية ، فانه لابد ان تكون معظم تلك المساحة الشريطية فى ماكية عامة (Most of The Belt is Public Owned))
وعند تطوير تخطيط أى مدينة يمكن أن يلعب ذلك الشريط الأخضر دورا هاما فى وضع تصور للمناطق الخضراء فى المدينة كلها واستغلال ذلك الشريط كرصيد للمدينة من تلك المناطق المفتوحة . ولقد ساعدت العوامل البيئية فى كثير من مدن العالم على توفير ذلك النطاق الاخضر حو المدينة كما فى المدن الأوربية على كل حال لاتكاد تخلو منه مدينة أوروبية ، ربما ساعد على ذلك سقوط الأمطار على مدار العام وفى المقابل ربما لا يوجد ذلك الشريط فى أى مدينة عربية .

انه يضيف متعة ورونقا للمدينة وما حولها County مما جعلهم يتغنون به :

It is My Delight to Be
Both in Town and Country

المناطق المفتوحة (Open Space) :

يستعمل هذا التعبير للدلالة على المساحات التى تخصص لاغراض غير بنائية وغير انتظار سيارات
(Not Covered With Cars Or Building)
وبالتالى فهى تشمل الأراضى الزراعية ، والانشطة الترفيهية الحرة
Outdoor Recrea Ional Uses.
الميادين SQUARE الحدائق PARKS
الحضرى URBAN SPACE
Open space is being sought for roads and utilities, shopping centers, factories roads side inns, airports, week-ends retreats etc.

التشجير فى المدينة :

تشمل عملية تشجير المدن عوامل اساسية تتمثل فى — النواحى الصحية لهذه المناطق الخضراء والاشجار من تاثير نفسى وتنقية للجو المحيط بالبيئة السكنية .

— النواحى الجمالية لما تضيفه على البيئة من جمال لاسيما اذا درس توزيع هذه الاشجار حسب الوانها وارتفاعاتها وانواعها واشكالها . الخ
وليس المقصود من عملية التشجير هو زرع اشجار أو شجيرات فى اى مكان وبدون اختيار لمواقعها واعدادها ، وانما لابد من دراسة هذا التوزيع من اجل تكامل عملية تجميل المدن (Land scape)

١ — يمكن ان يكون وضع الاشجار فى احد مداخل الميادين أو الشوارع لتكون بمثابة بوابة أو مدخل محدد .

٢ — كثيرا ما يصادف المخطط فراغا غير محدد فيعطى نوعا من الملل بما يضطر معه المخطط الى تشجير بعض ابعاده ليعطى تحديدا لذلك الفراغ لاسيما عندما يصعب تحديد ذلك الفراغ بعناصر بنائية أو يمكن بعناصر بنائية الا انها تحتاج الى توجيه معين يتعارض مع البعد المطلوب تحديده .

٣ — يمكن ان تمثل الاشجار بتكويناتها فى الميادين أو الشوارع الفسيحة ما يشبه الحدائق حيث تزود هذه المناطق بالمقاعد ويستظل الناس بهذه الاشجار .

٤ — يمكن استعمال الاشجار ذات الهيكل الدائرى فى شكل غطاء للفراغ (ميدان — شارع) بحيث يبدو الفراغ وكأنه مغطى .

٥ — يمكن وضع الاشجار على جانبى الطريق بابعاد متساوية فتكون تتابعا بصريا للمشاة وللدرجات أو راكبى الدراجات .

٦ — كما يمكن وضع شجرة او اكثر فى نهاية شارع لتكون بمثابة قفل نهاية المنظور أو نقله جذب .

التشجير واستخداماته فى عمليات تجميل المدن :

ليس اساس التصميم هو تغطية كل شىء بالاشجار أو الخضرة — وليست الاشجار بالشىء الذى يستخدم لحشو الأجزاء المتبقية أو لملء الفراغات غير المبنية . كذلك ليست القاعدة فى عملية تجميل الشوارع مثلا هى وضع صفين من الأشجار على جانبى الطريق ولذا يجب اعتبار الاشجار كمادة من مواد تصميم الموقع ، بحيث ان تتكامل مع المبانى والفراغات وممرات المشاه واستعمالات الطريق ... الخ .

وللنباتات اهمية بالغة فى عمليات التصميم الحضرى والبيئى -Urban and Environment منها على سبيل المثال ما يلى :

– تحديد وتشكيل الفراغات Space Forming

– اخفاء بعض المناطق الغير مرغوب فيهما أو اخفاء المناظر المرغوب فيها بغرض التشويق .

– اعطاء وحدة لبعض الفراغات ذات المبانى المختلفة مثلا فى شكل صفين من الاشجار على جانبى الشارع من نوع واحد . أو الأشكال المنتظمة من الاشجار بحيث يعطى كل نوع من هذه الاشجار الاشجار وحدة متكاملة .

– استغلال النباتات فى تظليل أماكن انتظار السيارات خاصة فى الدول الحارة مثل دول الخليج العربى .

وهناك أهمية خاصة لدراسة التشجير فى الفراغات وعلاقة تلك الفراغات ببعضها البعض بغرض قطع الملل . كما ان هناك علاقة بين الاشجار المستخدمة فى المشروع وانواع المبانى (احجامها – وارتفاعاتها) .

ولا يقتصر استعمال التشجير كعنصر جمالى فحسب ، بل يستفاد من ذلك أيضا فى وظائف اساسية لمعالجة بيئية مثلا استخدام النباتات القصيرة والشجيرات Smaller Plant لمنع أو توقف الاشعاع الحرارى الناتج من حرارة الشمس والمنعكس عن الأرض ، فتحول تلك النباتات القصيرة دون وصوله الى المبانى ، كما ان النباتات الطويلة (Tall Plants) تساعد الى حد كبير فى منع بريق الشوارع المرصوفة والذى يسبب زغللة العين سواء بالنسبة للسيارات أو المشاة (انظر الاشكال من ٥ – ١٨) .

استخدام النباتات كمصدات للرياح :

ان استخدام النباتات بدرجة كثيفة Dence Planning يمكن أن يؤدى الى تقليل سرعة الرياح Wind Speed بنسبة تتروح بين ٨٥٪ الى ٧٥٪(٤) .

واذا كانت الشجرة تحمى خلفها مساحة تقدر بثلاثة امثال ارتفاعها Wind Protect- فان تلك المسافة ليست كلها بدرجة واحدة من الحماية فالمسافة الأقرب من الشمس تعتبر حمايتها مثالية والمنطقة التى تليها مباشرة تعتبر حمايتها جيدة ثم اخيرا المنطقة الابعد (الثلث الأخير) تعتبر حمايتها مقبولة نسبيا (انظر الشكل ١٦ .

ثالثا : نسب المناطق الخضراء للمدن الحالية والجديدة بجمهورية مصر العربية والعالمية :

١ – نسب المناطق الخضراء للمدن الحالية بجمهورية مصر العربية :

تعتبر نسبة المناطق الخضراء فى مدن وقرى الجمهورية منخفضة جدا بالنسبة للمدن العالمية بل المشكلة الكبرى انها تتناقص عام بعد الآخر نتيجة اعتداء الأهالى على المناطق الفضاء والحدائق وبناء العمارات العالية . وهدم معظم الفيلات التى كان بها حدائق وتحويلها الى عمارات شاهقة .

فنجد ان متوسط نسبة المناطق الخضراء داخل المدن تصل الى حوالى ٥ر٣٪ من مساحة المدينه وهذه منخفضه جدا اذا قورنت بالمدن العالمية واذا نظرنا الى الجدول رقم (١) نجد أن نسبة المناطق الخضراء بمدينة رشيد وصلت الى ٢٪ وكوم حمادة بمحافظة البحيرة ٨ر١٪ والخانكة ٢ ٪ وأعلى نسبة مناطق خضراء كانت فى الحوامدية بالجيزة ٧٪ واسيوط ٥ر٦٪ مع ان هذه النسب انخفضت مرة أخرى فى الحصر الحالى .

وعلى ذلك نجد ان نسب المناطق الخضراء فى مدن جمهورية مصر العربية منخفضة ومستمرة فى الانخفاض .

٢ – نسب المناطق الخضراء فى المدن الجديدة بجمهورية مصر العربية :

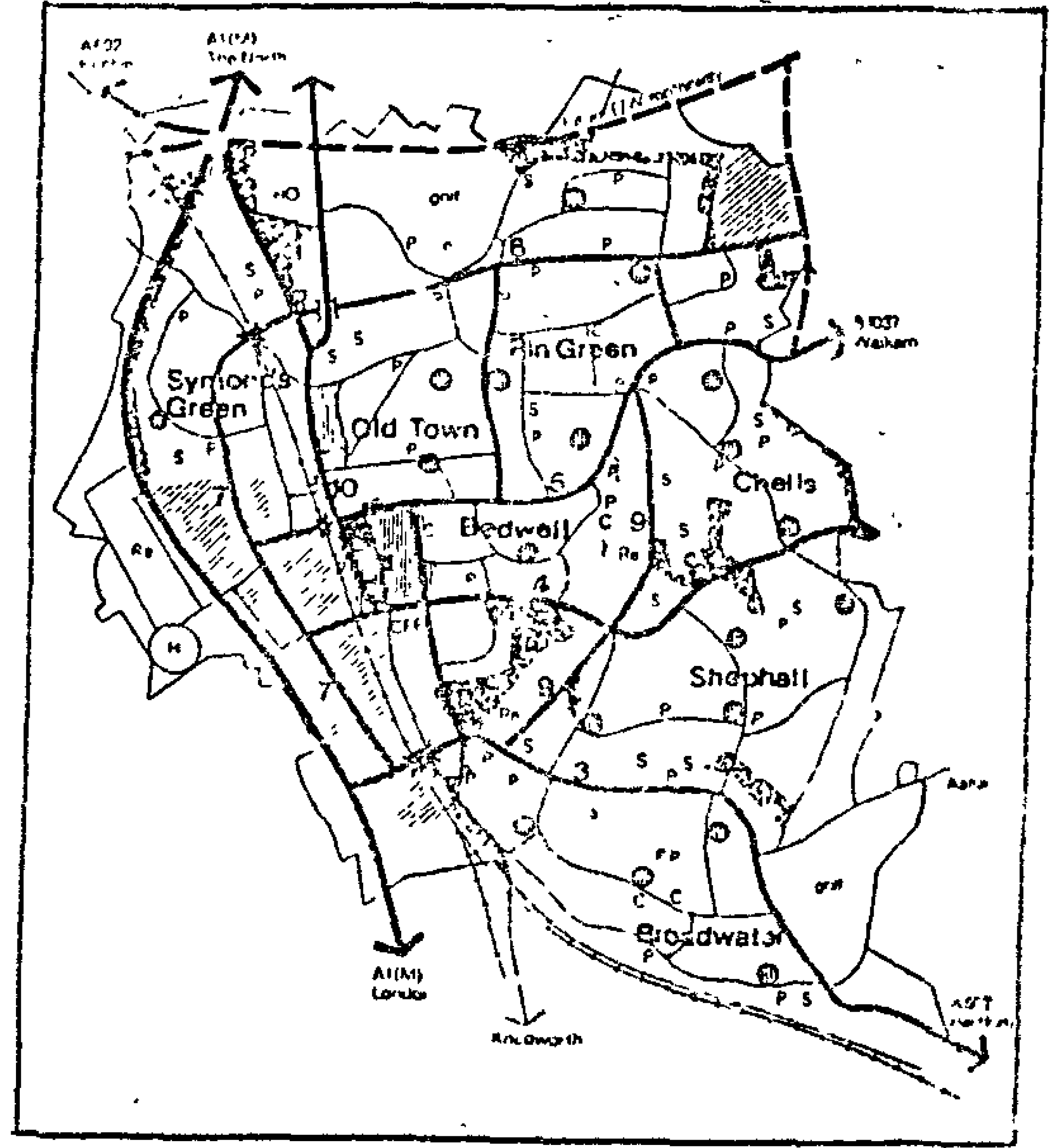
تعتبر نسبة المناطق الخضراء مرتفعة نسبيا بالنسبة لمدن الجمهورية حيث : متوسط هذه النسب هى حوالى ١١٪ حيث ان تخطيطها كان حسب المعدلات العالمية مع وضع الامكانيات الاقتصادية والظروف المتاحة فى الاعتبار وعلى ذلك كانت منخفضة عن نسبة المدن الجديدة العالمية (أنظر الجدو لرقم ١) .

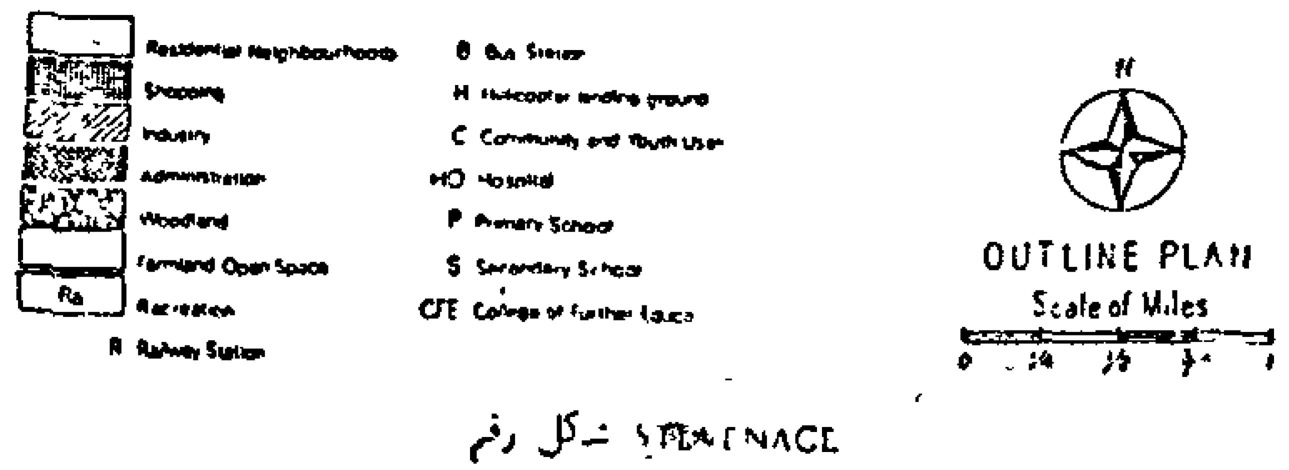
وقد وصلت نسبة المناطق الخضراء فى مدينة السادات ١٥٪ والعامرية ٨ر١١٪ ومدينة العاشر من رمضان ٨٪ ومدينة ٦ أكتوبر ٤٪ ، وعلى ذلك نجد ان النسب ترتفع وتنخفض فى نسب منخفضة الى حد ما بالنسبة للنسب والمعدلات العالمية (انظر الجدول رقم ٢)ه .

٣ – نسب المناطق الخضراء بالمدن الجديدة العالمية :

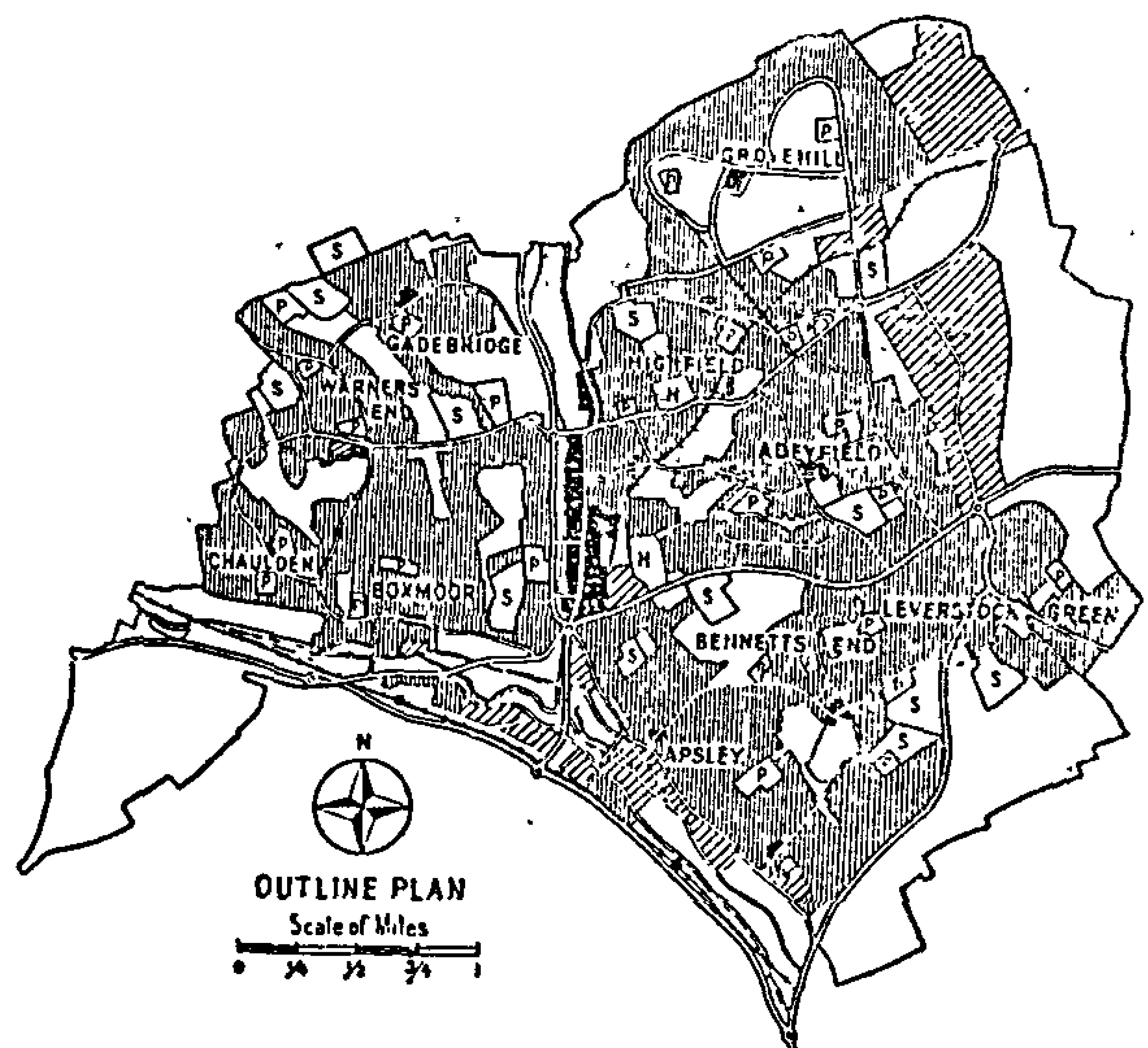
ان نسبة المناطق الخضراء بالنسبة للمدن الجديدة ببعض الدول العالمية فى المعدلات

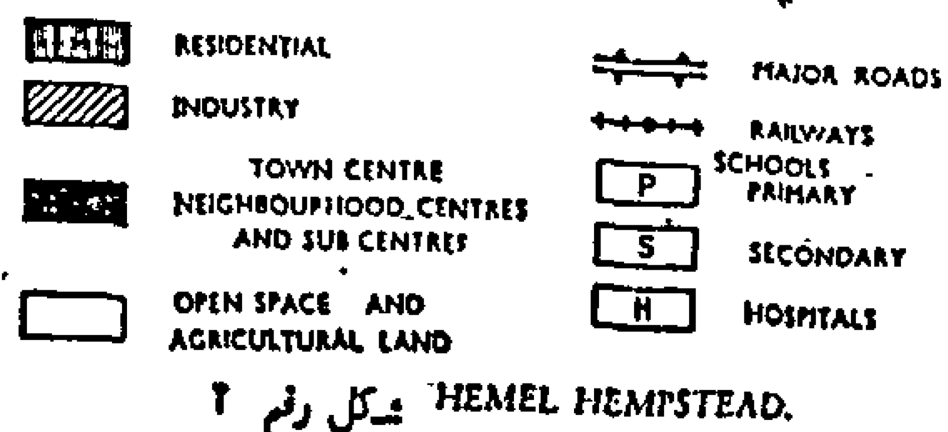
القياسية حيث ان مدينة باسيلدون فى المملكة المتحدة تصل فيها المناطق الخضراء الى ٣٨ ٪ ومدينة كوميران ١٤٪ ومدينة ريدفش ٢١٪ ونجد ان متوسط نسبة المناطق الخضراء فى بعض المدن الجديدة بالمملكة المتحدة ٢٤٪ من مساحة هذه المدن وهى نسب مناسبة جدا لهذه المدن الجديدة وتعتبر حوالى ضعف نسب المناطق الخضراء فى المدن الجديدة بجمهورية مصر العربية وحوالى عشرة اضعاف نسبة المناطق الخضراء بالمدن الحالية بجمهورية مصر العربية (انظر الجدول رقم ٣)٩ (وانظر الأشكال من ١ — ٩٤).



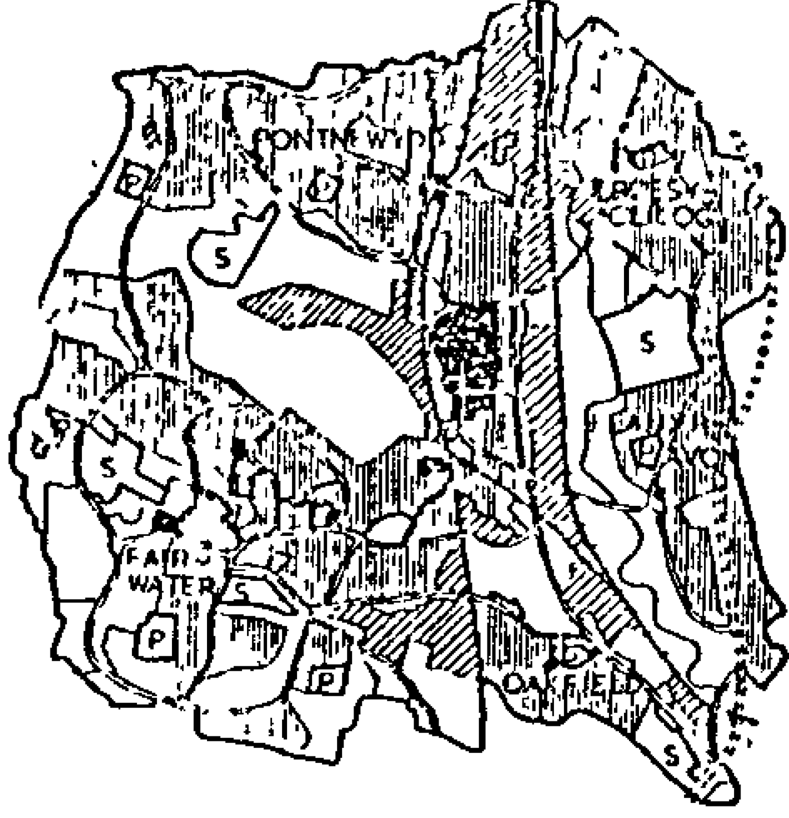


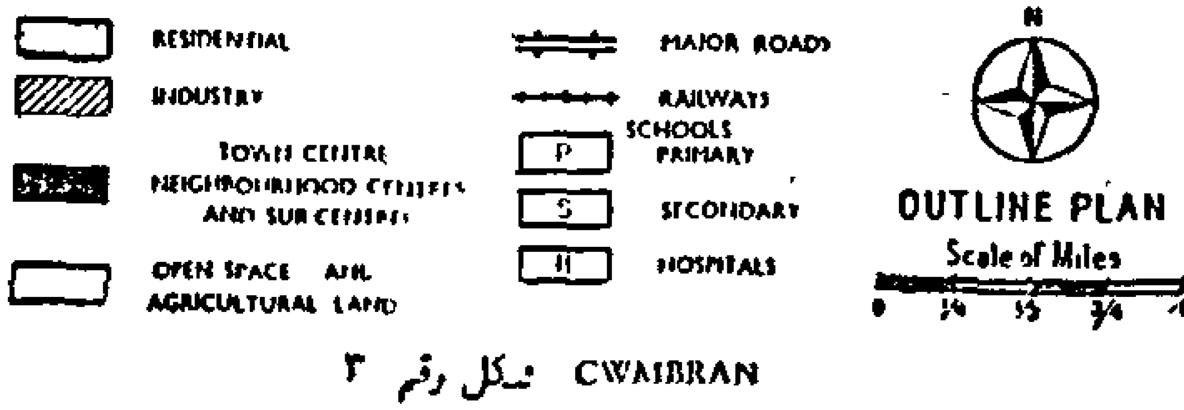
شكل رقم STEVENAGE



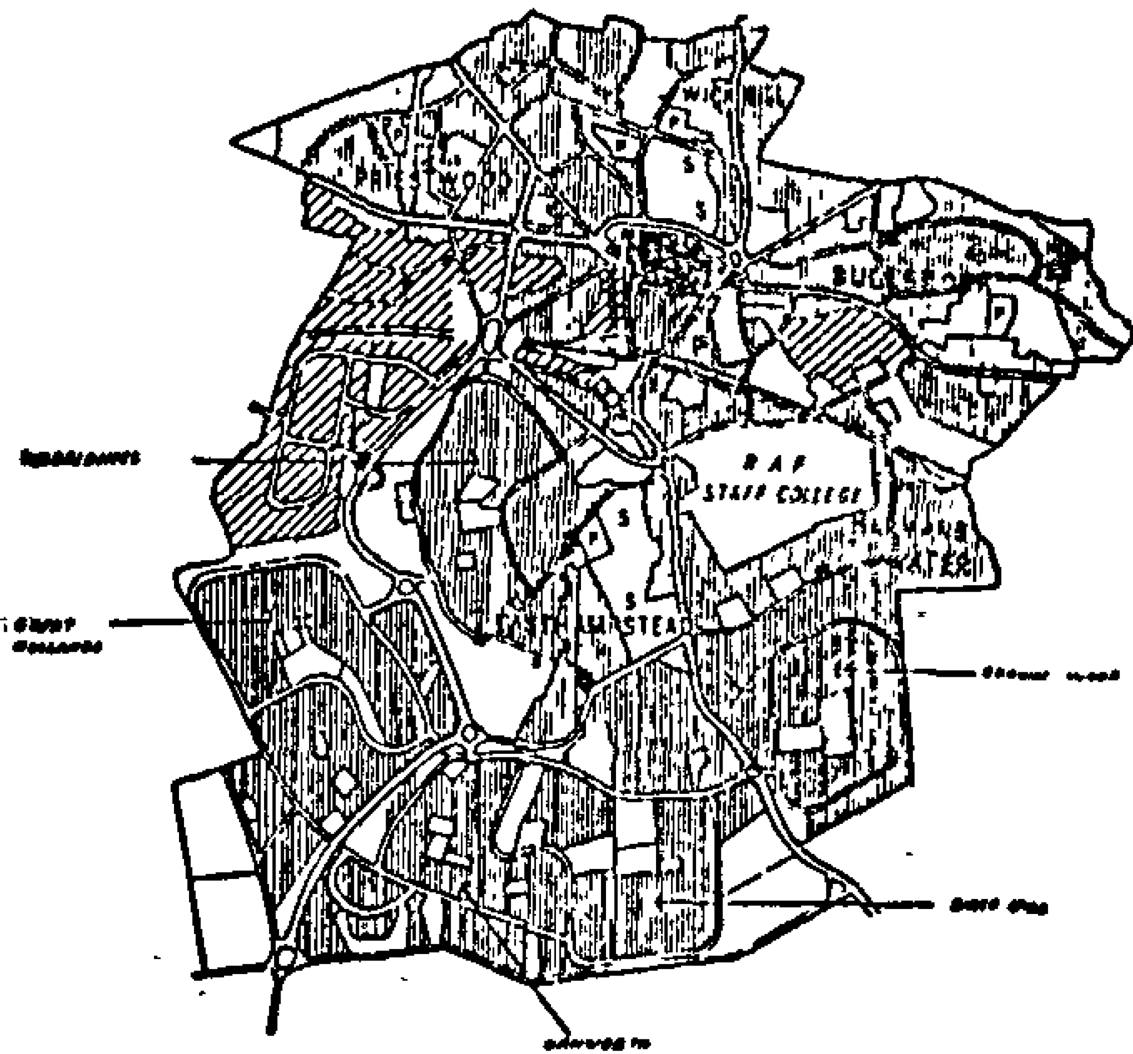


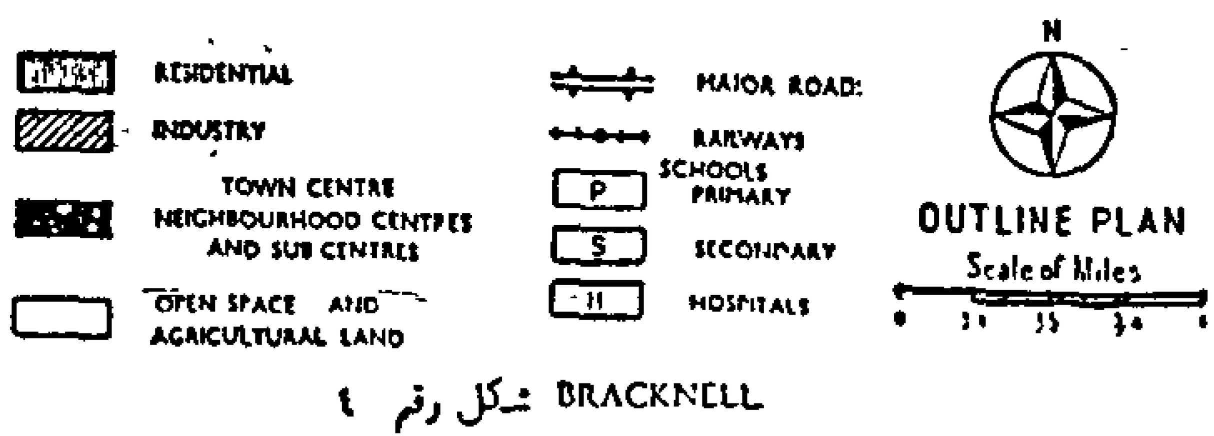
شكل رقم ٢ HEMEL HEMPSTEAD.



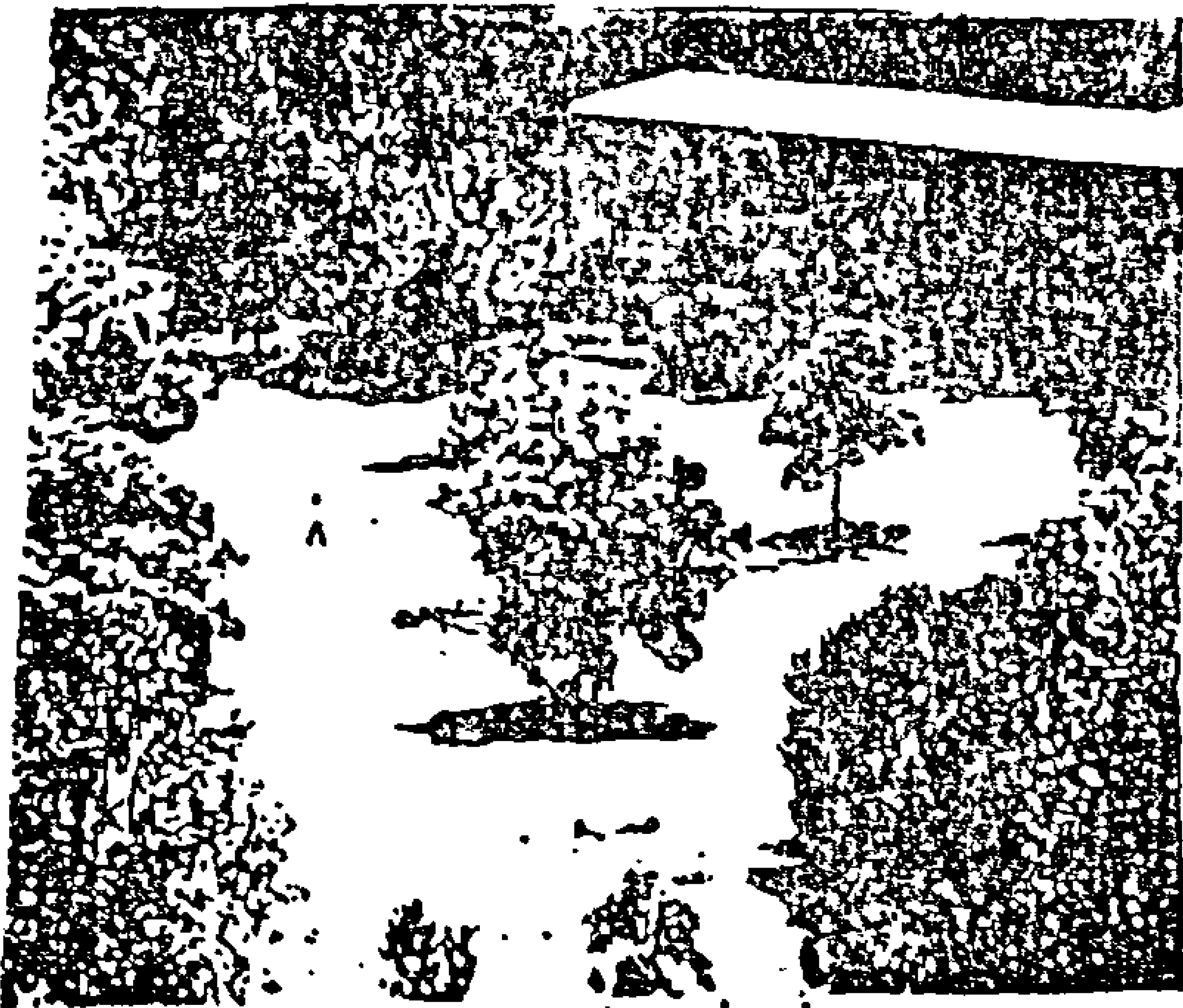


شكل رقم ٣ CWMBRAN

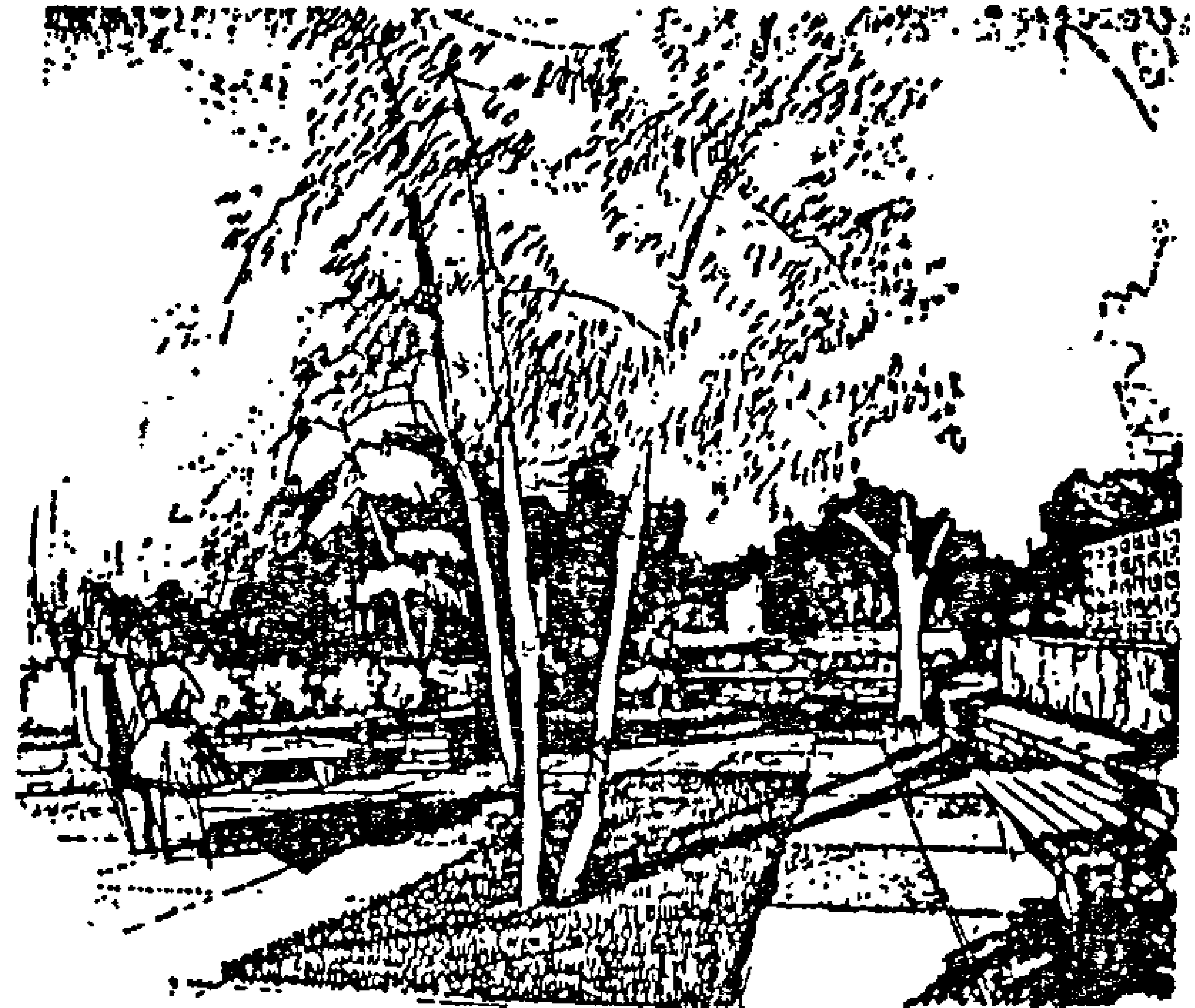




شكل رقم ٤ BRACKNELL

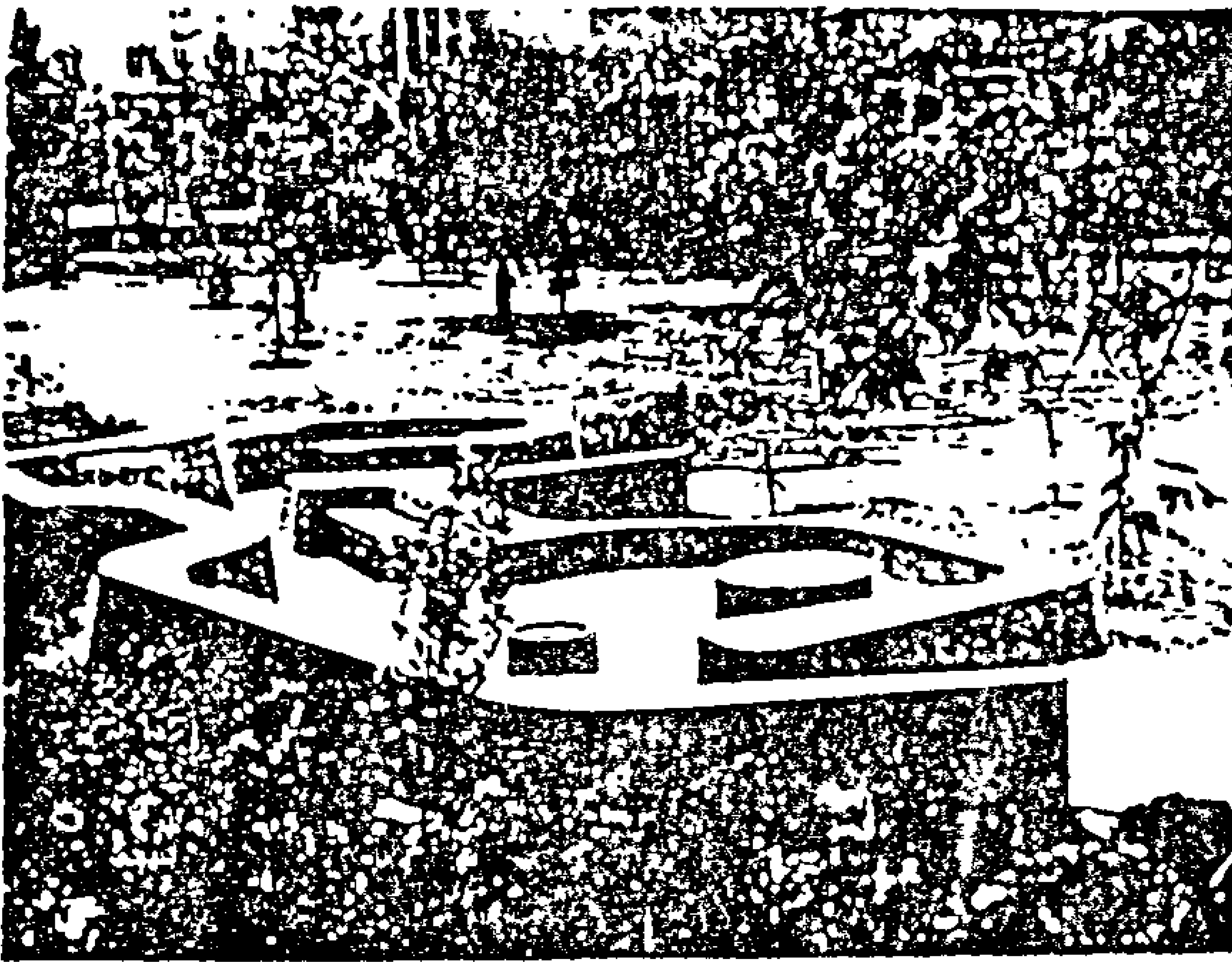


شكل رقم ٥ التشجير والمسطحات الخضراء وممرات المشاة

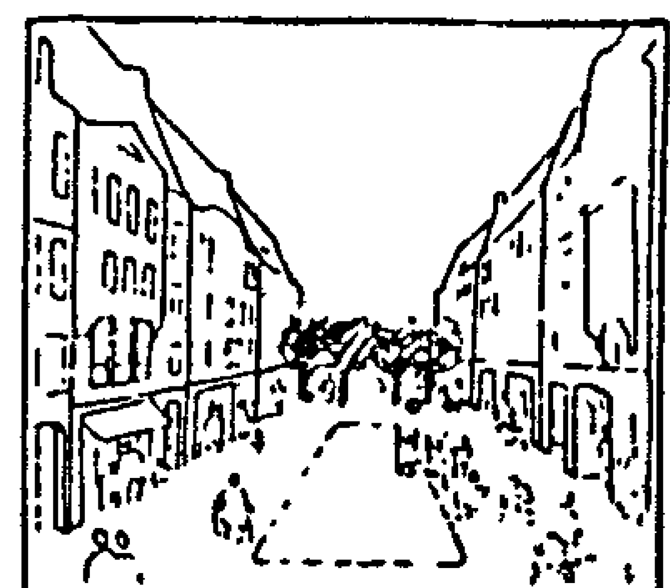


شكل رقم ٦ تكامل عناصر تنسيق الموقع، الاشجار - الشجيرات - المقاعد - المسطحات الخضراء - المياه - حوائط الفرغ - احواض الزهور

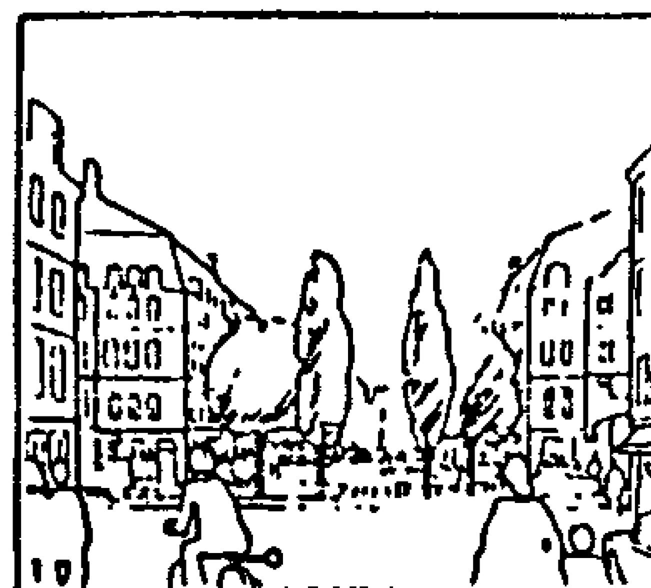
PREPARATION AND IMPLEMENTATION OF LANDSCAPE PLANS



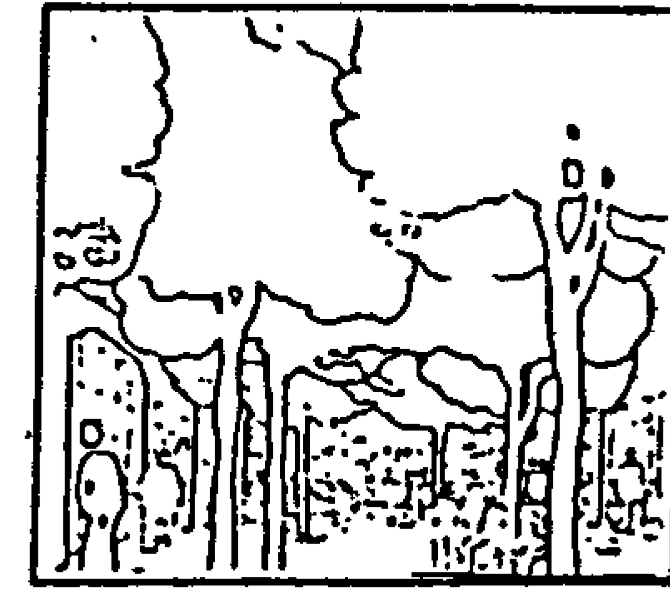
شكل رقم ٨ التشجير واختلاف المناسيب



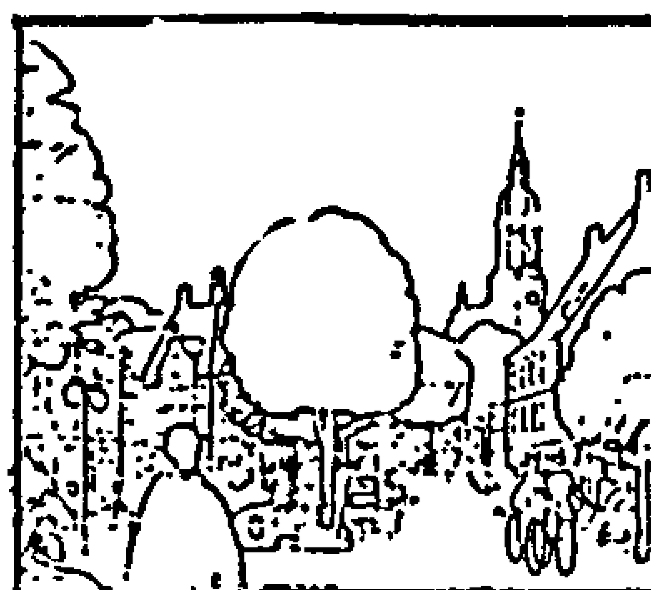
أ - تحديد الفراغ space



ب - بوابة أو مدخل Gate



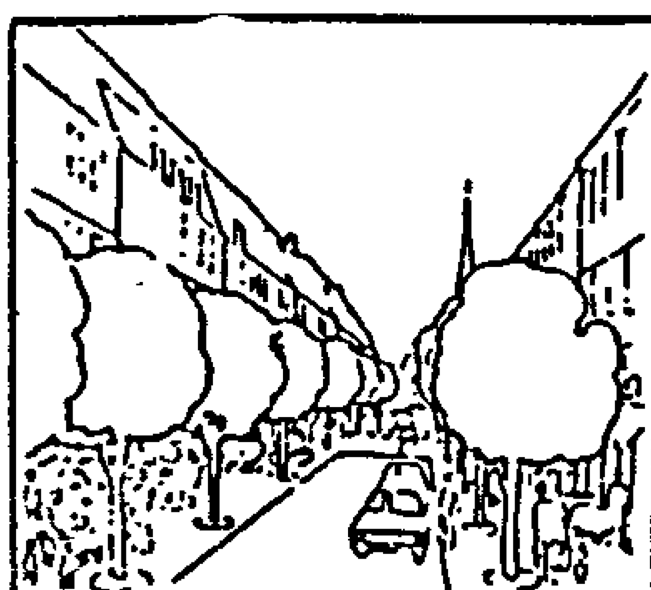
د - غطاء Cover



جـ - حديقة Park



و - نقطة جذب Focus point

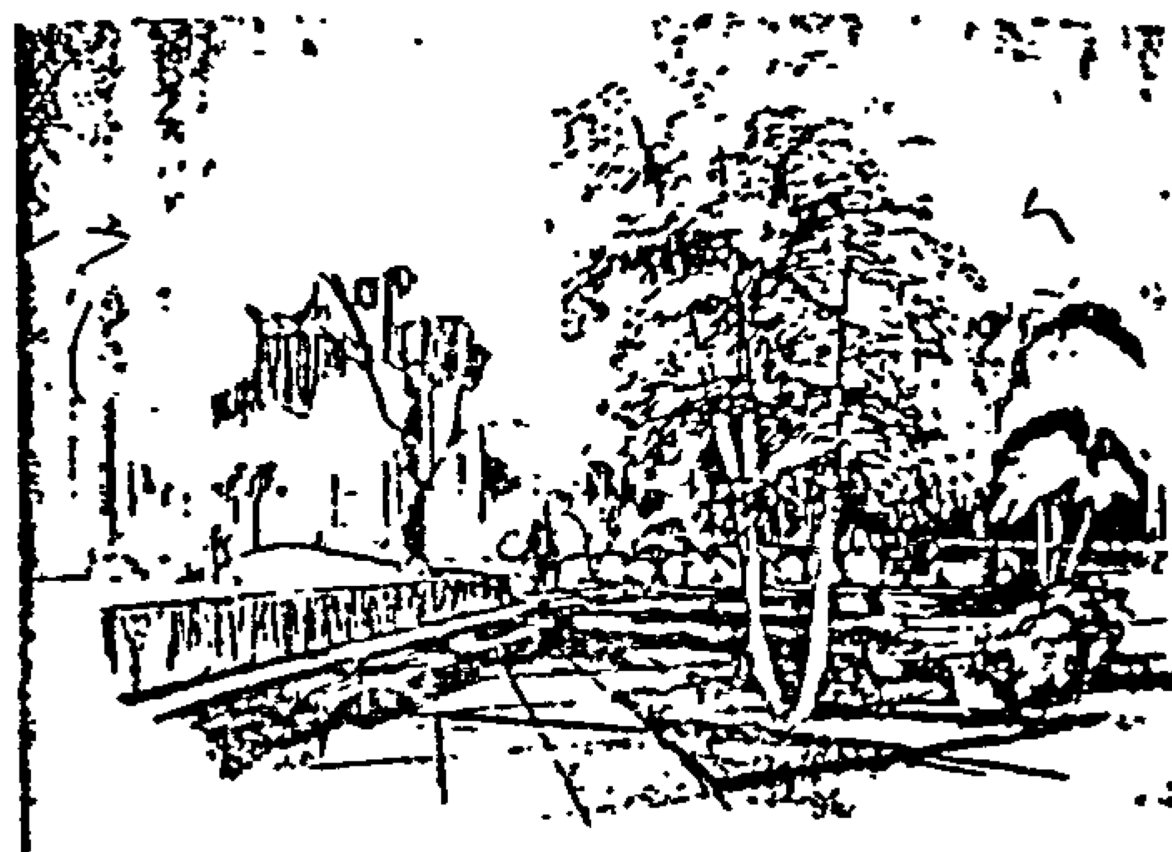


هـ - التشجير على الجانبين Allee

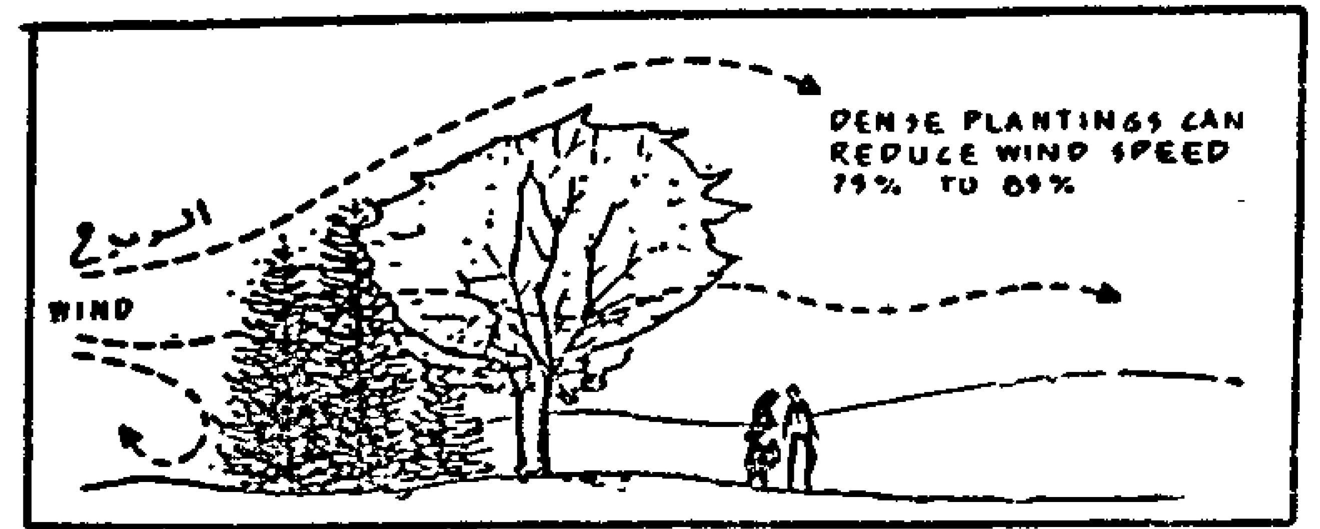
شكل رقم ٧ نماذج من استخدامات التشجير في التصميم الحضرى



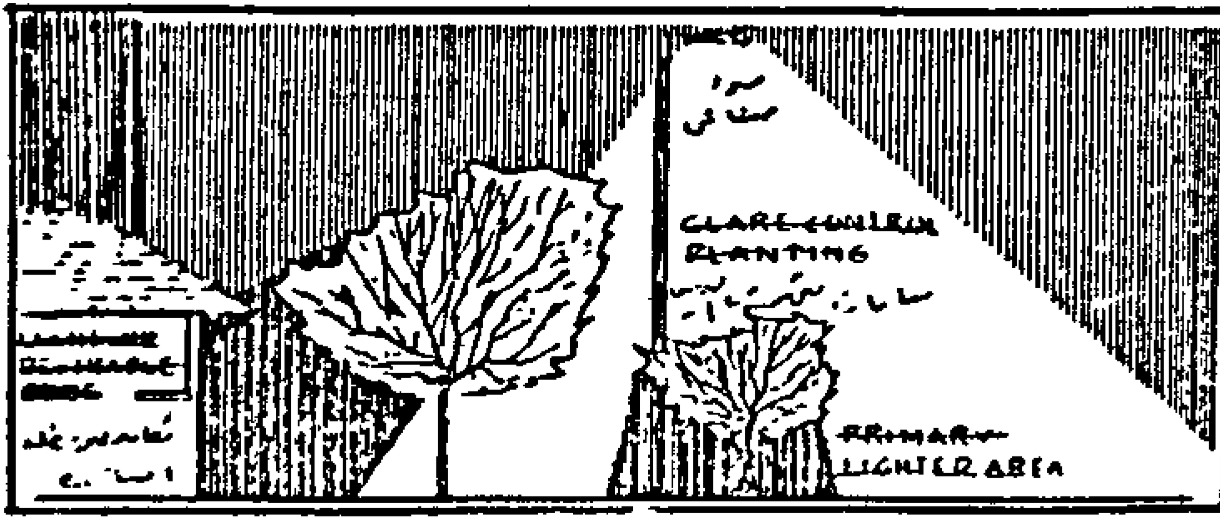
شكل رقم ٩ استغلال التشجير في شكل حديقة في الفراغ الرئيسى



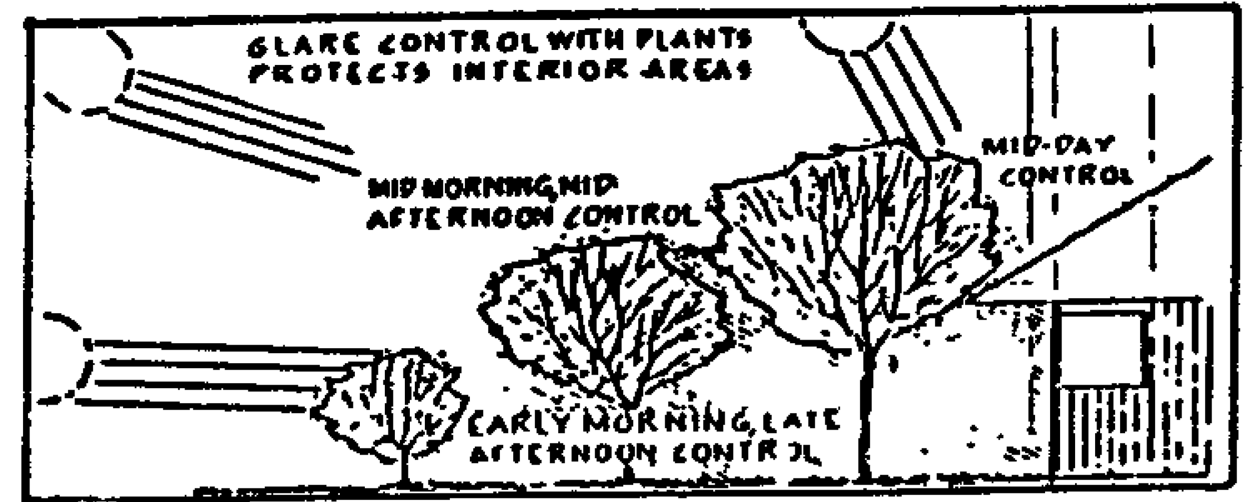
شكل رقم ١٠ منظور يوضح استخدام التشجير كعنصر في تجميل الموقع خاصة عندما تظهر الاشجار والتجميعات كجزء من التشكيل العضوى للموقع



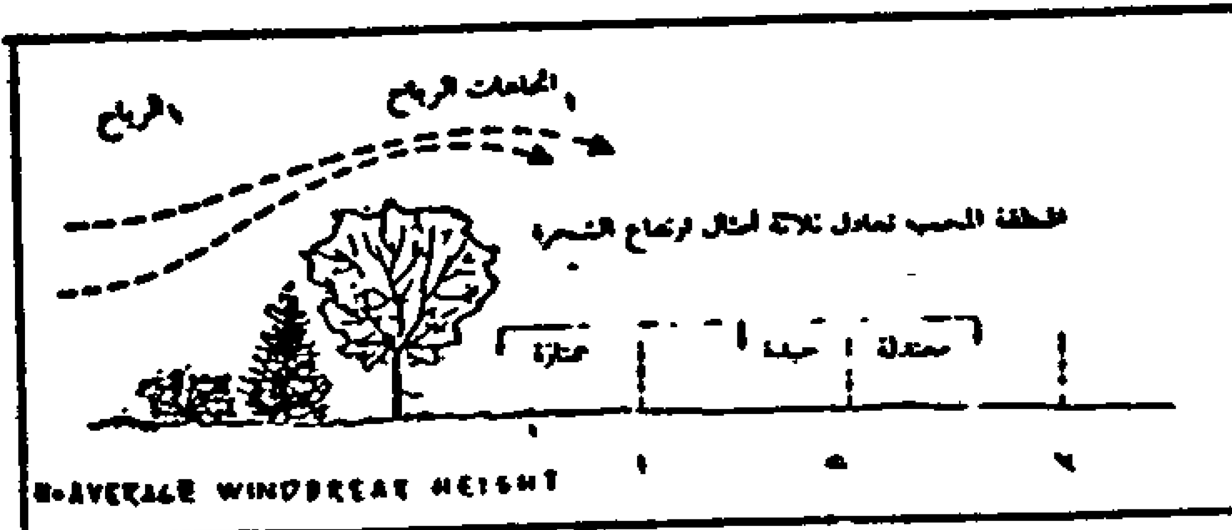
شكل رقم ١١ : استخدام النباتات كمصدات للرياح



شكل رقم ١٥ التشجير لحماية المساحات الداخلية ليلا



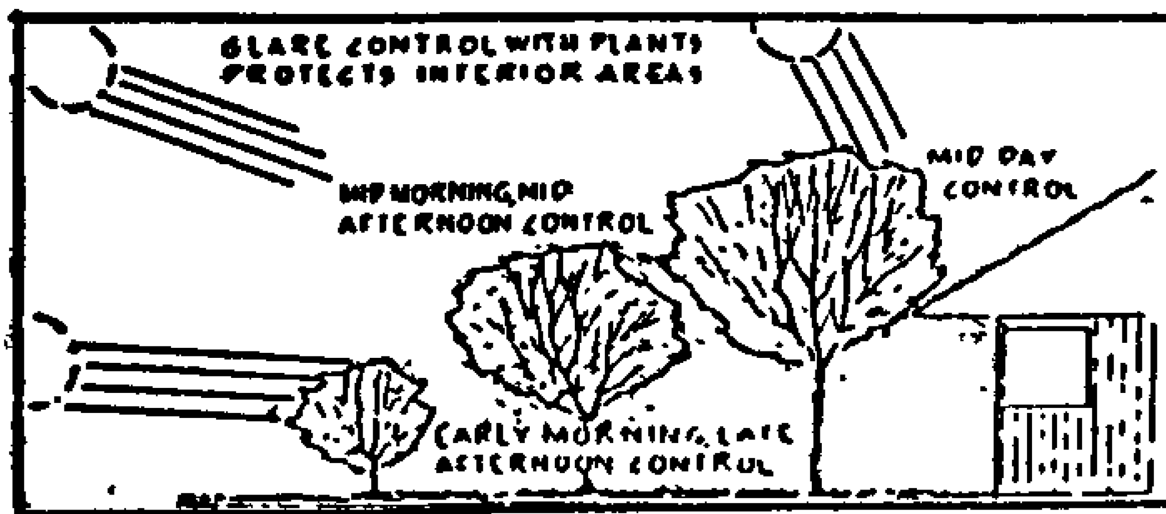
شكل رقم ١٢ التشجير لحماية مبنى



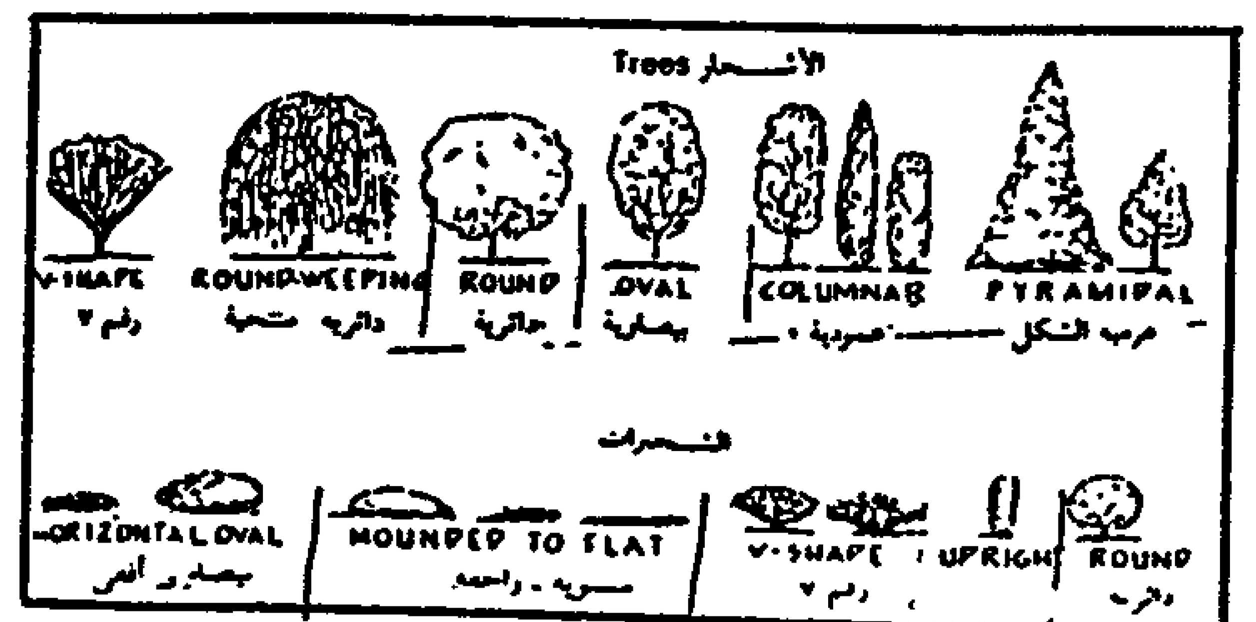
شكل رقم ١٦ العلاقة بين المنطقة المحمية من الرياح وارتفاع النباتات



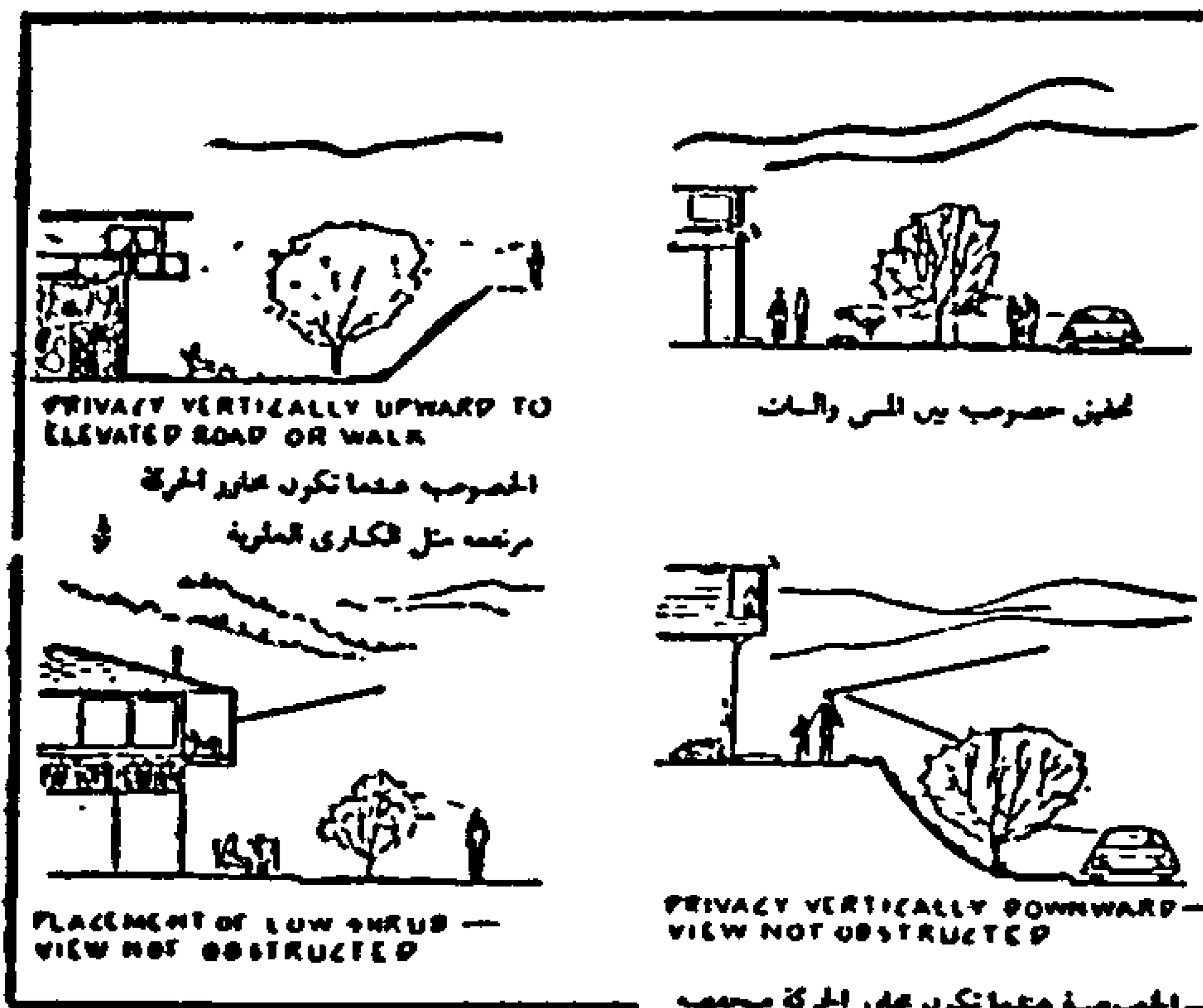
شكل رقم ١٣ بعض استخدامات التشجير ل المدينة



شكل رقم ١٧ التشجير لحماية مبنى



شكل رقم ١٤ بعض الأنواع الشائعة من الأشجار والشجيرات



شكل رقم ١٨ تحقيق الخصوصية باستعمال النباتات

جدول رقم ١ – نسبة المناطق الخضراء فى بعض المدن بجمهورية مصر العربية

اسم المدينة	رشيد	كوم حمادة	اشمون	سمنود	بلبيس	الخانكة	دمياط	الحوامدية	اسيوط	مغاغة
النسبة %	٢	١ر٨	٢	٤ر٦	٣ر٢٥	٢ر٢	٤	٧	٦ر٥	٢

جدول ٥٢ نسبة المناطق الخضراء فى بعض المدن الجديدة بجمهورية مصر العربية

اسم المدينة	١٠ رمضان	الامل	السميس	السادات	٦ اكتوبر	العامرية	بور سعيد	حلوان	مدينة نصر	١٥ مايو
النسبة ٪	٨	٧٫٦	٦	١٥	٫٤	١١٫٩	١٠	١٢	٢٢	٢٣٫

جدول ٩٣ نسبة المناطق الخضراء والفضاء فى بعض المدن العالمية

اسم المدينة	ايست كيلوبرد	براكنل	كومبرنالد	كوافيران	جلانروسيس	برادكيل	هيمل هيمپستيد	ستنناج	ريدنش	بالسيلدون
النسبة ٪	٢١	٢١	٣٧	٢٤	١٧	١٦	٢٦	٢٣	٢١	٣٨

رابعا : التوصيات :

١ – تخطيط المناطق الخضراء على المستوى الدولى والقومى والاقليمى :

(ا) الغابات :

كى تبقى الغابات محافظة على انتاجيتها وعلى ميزاتها البيئية – بالنسبة للانسان – يجب أن تبقى محافظة على توازنها البيولوجى المسئول عن خصوبة التربة .

ولذلك فان اى برنامج لادارة واستثمار الغابات يجب ان يأخذ بعين الاعتبار ضرورة استثمار هذه الغابات مع المحافظة دوما على توازنها التيولوجى .

وتشكل السيول السبب الرئيسى فى تدهور الغابات وانجراف التربة ومن ثم فعلى المخطط ان يتخذ مجموعة من التدابير لمنع تدهور الغابة . والتى يمكن تلخيصها فيما يلى :

– تشجيع تعدد الانواع النباتية فى الغابات للمحافظة على خصوبة التربة وزيادة استقرار الغابة . ولما كانت الاهداف الاقتصادية من استثمار الغابات لا تسمح بزيادة عدد انواع الاشجار فى الطبقة العلوية من الغابة . فانه يمكننا تشجيع تعدد الانواع فى طبقة تحت الغابة .

– تلافى طرق القطع التى يمكن ان تؤدى الى تعرية التربة ، وبالتالى الى انجرافها وافقارها العناصر المعدنية المغذية ، مما ينعكس على امكانية تجدد الغابة والمحافظة على توازنها. ففى بلاد البحر الابيض المتوسط حيث يتميز المناخ برخات مطرية قوية فانه يجب منع القطع الكلى للغابات الذى يعرض ارض الغابة لعبث الامطار القوية واتباع طريقة القطع التدريجى .

– مكافحة الحرائق بشتى الوسائل البيولوجية والميكانيكية . ان الغابات المختلطة هى اكثر مقاومة للحرائق من الغابات النقية الوحيدة النوع ، وفى كل المناطق الحراجية يجب ان تجهز مراصد مناخية لدراسة الأحوال الجوية والتنبؤ عن احتمال حدوث الحرائق ، كما يجب انشاء شبكة من الطرقات الكافية للوصول الى مكان الحريق داخل الغابة عند حدوثه ، وتدريب فريق من الاختصاصيين فى اطفاء الحرائق ومجهز بأحدث الوسائل .

– مكافحة الرعى الجائر داخل الغابات ، ومنع الماعز من الرعى داخل الغابات فى مرحلة تجدد الغابات حيث تكون الغراس صغيرة فيجب منع الرعى منعا نهائيا .

– مكافحة الافات التى تصيب اشجار الغابة وبقدر الامكان بالطرق الحيوية .

(ب) المراعى الطبيعية :

من الضرورى المحافظة على المراعى الطبيعية ومنع تدهورها ، وذلك للمحافظة على البيئة من جهة وعلى انتاجيتها من جهة اخرى ، وهذا يتطلب وضع نظام تخطيطى ادارى لاستغلال المراعى الطبيعية نابع من علاقة المجتمعات النباتية المكونة لهذه المراعى مع البيئة وحاجة الانسان . ان وضع هذا النظام لا يمكن ان يتم الا بعد اجراء دراسات بيئية واجتماعية نباتية لمناطق المراعى الطبيعية ، وكذلك دراسة تحملها للرعى بحيث تسمح هذه الدراسات فى النهاية الى تحديد عدد رؤوس الحيوانات فى الهكتار مع تأمين تجددها باستمرار .

(جـ) الأراضي الزراعية :

ان الادارة الحكيمة للاراضى الزراعية تهدف الى استثمارها بغية الحصول على افضل النتائج كما ونوعا مع المحافظة على خصوبة التربة وعلى التوازنات التخطيطية البيولوجية الضرورية لسلامة الأرض الزراعية .

يجب على الإنسان ان يتبع سياسة لاستثمار الأراضي الزراعية نابعة من فكرة المحافظة على استمرار توازن البيئة ، ولذلك فان كل الطرق المستعملة فى الزراعة من حيث تحضير التربة وانتخاب نوع المحصول والدورة الزراعية ونوع السماد المعدنى والعضوى وكذلك من حيث مكافحة الافات المتنوعة التى تصيب المحاصيل ، كل ذلك يجب ان ينتخب بحيث لا يتعارض مع القوانين الطبيعية التى تخضع لها التوازنات البيولوجية المسئولة عن استمرار خصوبة البيئة . وعلى ذلك يجب اتباع ما يلى :

ـ الاهتمام بتعدد المحاصيل فى دورة زراعية متوازنة : وجدنا سابقا ان الزراعات الوحيدة المحصول المتكررة على نفس الأرض هى من أهم الاسباب فى تدهور خصوبة التربة . وقد دلت التجارب فى كثير من بلاد العالم ان الزراعة المتعددة المحاصيل التى تتوالى فى دورة زراعية متوازنة تساعد على المحافظة على التربة وعلى خصوبتها وتخفف جدا من ضياع مياه الامطار .

ـ تحسين بنية التربة الزراعية عن طريق اضافة المادة العضوية ومكافحة الانجراف وتحسين الخواص الفيزيائية للتربة وتخصيب الاراضى الزراعية .

ـ عمل تخطيط من خلال تخطيط اقليمى للاراضى الزراعية ينصب على نوعية الزراعات والمجتمعات العمرانية المعتمدة على هذه الزراعات .

٢ ـ تخطيط المناطق الخضراء على المستوى المحلى (مدن ـ قرى) :

تعتبر المناطق الخضراء والحدائق والمتنزهات والملاعب عنصر هام واساسى فى تخطيط المدن والقرى وبدونها مهما وصلت المدينة من مستوى عمرانى تعتبر غير متكاملة . وعلى ذلك يجب عند تخطيط المدن والقرى مراعاة ما يلى :

ـ ضرورة توفير اماكن وحدائق تطل عليها وتتخللها وتمثل الحائط الخارجى والمحيط الحقيقى لها . وأيضا كمناطق ترويحية وملاعب وحدائق عامة .

ـ الحفاظ على المناطق الخضراء فى المدن الحالية من الامتداد العمرانى ووضع القوانين الرادعة لحماية المناطق الخضراء والاراضى الزراعية المحيطة بالمدن والقرى .

ـ محاولة رفع نسبة المناطق الخضراء والمفتوحة فى المدن الحالية عن طريق عمل تخطيط عام للمدينة وعمل خلخلة داخل التكدسات العمرانية وانشاء حدائق ومتنزهات وملاعب لرفع نسبة المناطق الخضراء فى مدن وقرى جمهورية مصر العربية الى حوالى ضعف الحالى ومحاولة الوصول الى حوالى ١٠ ٪ من مسطح المدينة .

ـ وضع القوانين اللازمة لضرورة عدم زيادة نسبة المبانى فى اى قطعة أرض من ٥٠ ٪ من المسطح والباقى حدائق .

ـ الاهتمام باستخدام الاشجار والمناطق الخضراء فى معالجة المشاكل المعمارية وحجب المناظر الغير مناسبة الرؤية والاهتمام بالناحية البصرية فى تخطيط المدن .

ـ مراعاة علاقة عدد السكان ومساحة المناطق الخضراء ونسبة استخدام الاكسجين الناتج من المناطق الخضراء ونسبة ثانى اكسيد الكربون الناتج من الانسان والمصانع وعوادم السيارات على الوصول الى توازن مناسب وحسب نوعية الاشجار والمناطق الخضراء المناسبة لعدد السكان .

ـ تحديد نسبة المناطق الخضراء للمدن الحالية والجديدة مع مراعاة وظيفة المدينة سواء كانت ساحلية او فى وسط صحراء او فى وسط مناطق زراعية أو بجوار غابات أو مراعى على الا تقل عن ١٥ ـ ٣٠ م٢ للفرد بنسبة تتراوح ما بين ١٠ ـ ١٥ ٪ من مسطح المدينة٢ .

ـ يجب عند انشاء المدن الجديدة الوصول الى النسب والمعدلات المناسبة لحياة الانسان وخاصة فى المدن الصناعية والاهتمام بالتوسع الافقى وخاصة فى المدن الصحراوية .

ـ يجب انشاء طرق وممرات حدائقية تربط المدينة ووحداتها المختلفة وكذلك تخطيط شوارع حدائقية حرة تماما من حركة المرور تربط مناطق الترويح المختلفة والمناطق الخضراء المفتوحة .

المراجـــع

١ ـ أ . د / أحمد امين مختار ـ تخطيط المناطق الخضراء والمفتوحة .

٢ ـ أ . د / محمـد عباس الزعفـرانى ـ المناطق الخضراء والمفتوحة وتأثيرها على تخطيط المـدن .

٣ ـ أ . د / احمد خالد عـلام ـ تخطيط المـدن .

٤ ـ د / أحمد كمال الدين عفيفى ـ دراسات فى التخطيط العمرانى .

٥ ـ الهيئة العامة للتخطيط العمرانى / مركز بحوث التنمية والتخطيط التكنولوجى .

٦ ـ هيئة المجتمعات العمـرانية الجـديدة (مدينة السادات ـ مدينة العاشر من رمضان مدينة ٦ أكتوبر) .

7. BATES M. 1964 - MAN IN NATURG PRENTICE - HALL INC, NEW GERSEY 71P.

8. ASHBY M. 1969 - AN INTRODUCTION TO PLANT ECOLOGY SEC. EDITION MCMILLAN LONDON 287 P.

9. FREDERIC J. OSBARN & ARNOLD WHITTICK NEW TOWS. THEIR ORIGNS

ACHIEVEMENTS ASD PROGRESS LEONARD-HILL LONDON 1977.

10. PEIRRE MERLLN NEW TOWNS REGIONAL PLANNING AND DEVELOPMENT TRANSLATED TO ENGLISH BY M. SPARKS METHUEN AND CO, LTD - NEW YORK 1971.

11. REBUILDING CITIES. JOHNSON-MARSHALL UNIVERSITY OF EDINBURGH.



نبدى NEPDI

أو

المعهد الوطني المصري لتطوير التعبئة والتغليف

كان حلماً فأصبح حقيقة !! وكان أملاً وتحقق الأمل ..

فعلى طريق القاهرة الإسماعيلية .. وفي مدينة العاشر من رمضان يطالعنا عن قرب مبنى شامخ .. هو

المعهد الوطني المصري لتطوير التعبئة والتغليف

ومن خلال تعاون مصري فرنسي مشترك أقيم هذا المعهد

أحدث معهد لإختبارات العبوات في الشرق الأوسط وأفريقيا وحيث قدمت فرنسا تكنولوجيتها للتنفيذ ودفع المعهد ليفي باحتياجات البلاد خاصة في مجال تطوير التعبئة والتغليف للمواد المصدرة إلى الخارج .. لتكون الواجهة المشرفة لشعار «صنع في مصر» وهو ما ينادي به السيد الرئيس

محمد حسني مبارك

كما قام المعهد الوطني الفرنسي والتابع لوزارة التنمية الصناعية والتجارة الخارجية الفرنسية بتقديم المعونة الفنية لإقامة هذا المعهد.

بمجمع شمتو لتعبئة المواد الغذائية .. بمدينة العاشر من رمضان

ويتكون المعهد من :

- **معامل تخصصية في :**
  - تحليل خامات وعبوات الورق.
  - إختبارات عبوات النقل والتعاون وإختبارات العبوات وبداخلها المنتج
  - تصميم العبوات.
- **قاعات :**
  - للإجتماعات. للندوات. للمؤتمرات المتخصصة في التعبئة والتغليف
  - للمحاضرات. لتدريب الكوادر المصرية والعربية والأفريقية في التعبئة والتغليف.
- **بنك المعلومات :**
  - متصل بأغلب المعاهد العالمية في التعبئة والتغليف في أوروبا وأمريكا.

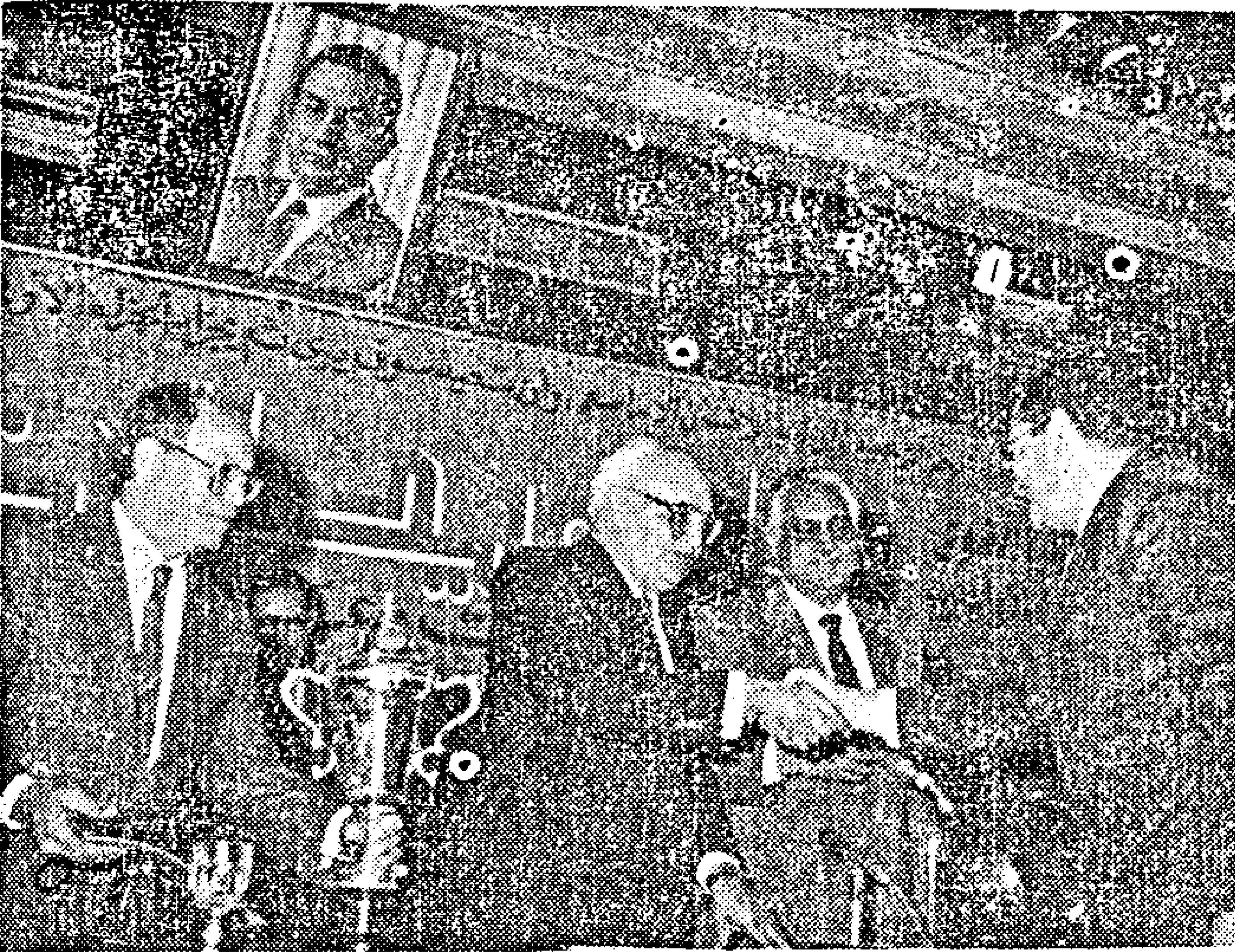
هذا هو : نبدى NEPDI

«رفاهية مصر أمانة لدى عقل وسواعد كل مصرى»

بتروجت

شركة المشروعات البترولية والاستشارات الفنية

إحدى شركات الهيئة المصرية العامة للبترول



بتروجت
تفوز بكأس الإنتاج لعام ١٩٨٧

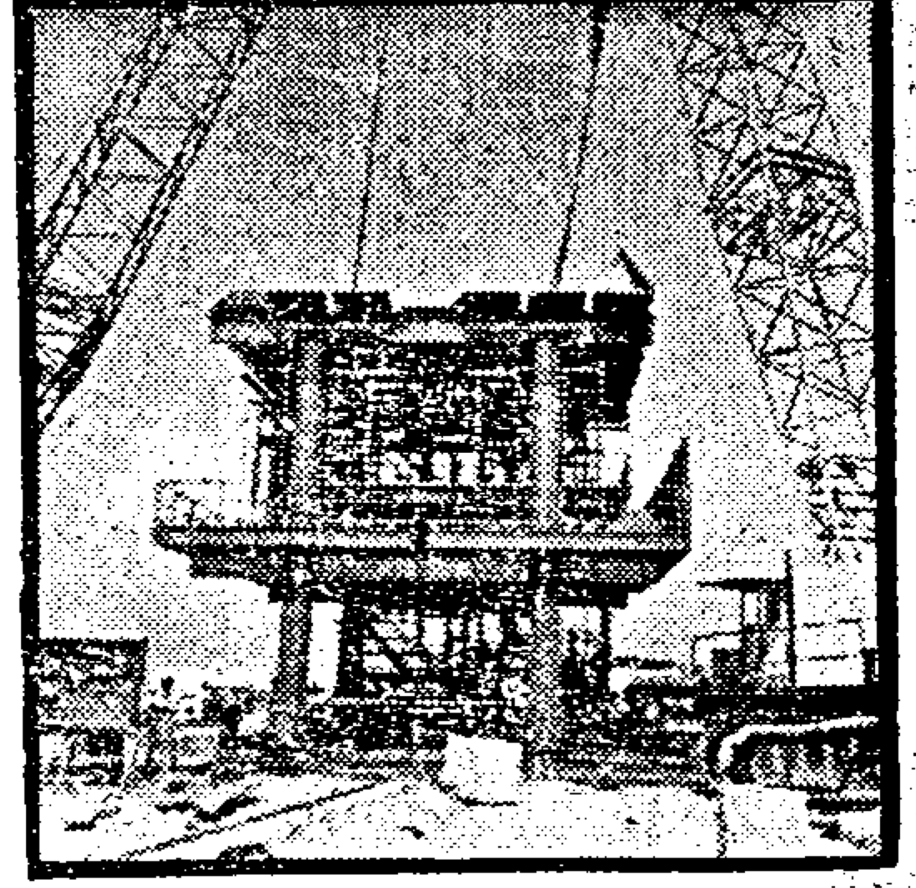
قام السيد الأستاذ الدكتور/ **عاطف صدقى**
رئيس مجلس الوزراء
بتسليم السيد المهندس/ **كمال مصطفى**
رئيس مجلس إدارة بتروجت
كأس الإنتاج لعام **١٩٨٧** فى حفل
عيد الإنتاج بحضور السيد الكيميائى
عبد الهادى قنديل
وزير البترول والثروة المعدنية

حقاً .. إن **بتروجت** إحدى قلاع الصناعة الكبيرة التى تقوم بالإنشاءات البترولية والصناعية وفوز بتروجت بكأس الإنتاج لعام ١٩٨٧ لم يكن وليد الصدفة ولكنه نتاج جهد وعرق العاملين الشرفاء ببتروجت الذين أنشأوا معمل تكرير بترول أسيوط «أحدث وأكبر مشروع بترولى فى مصر»

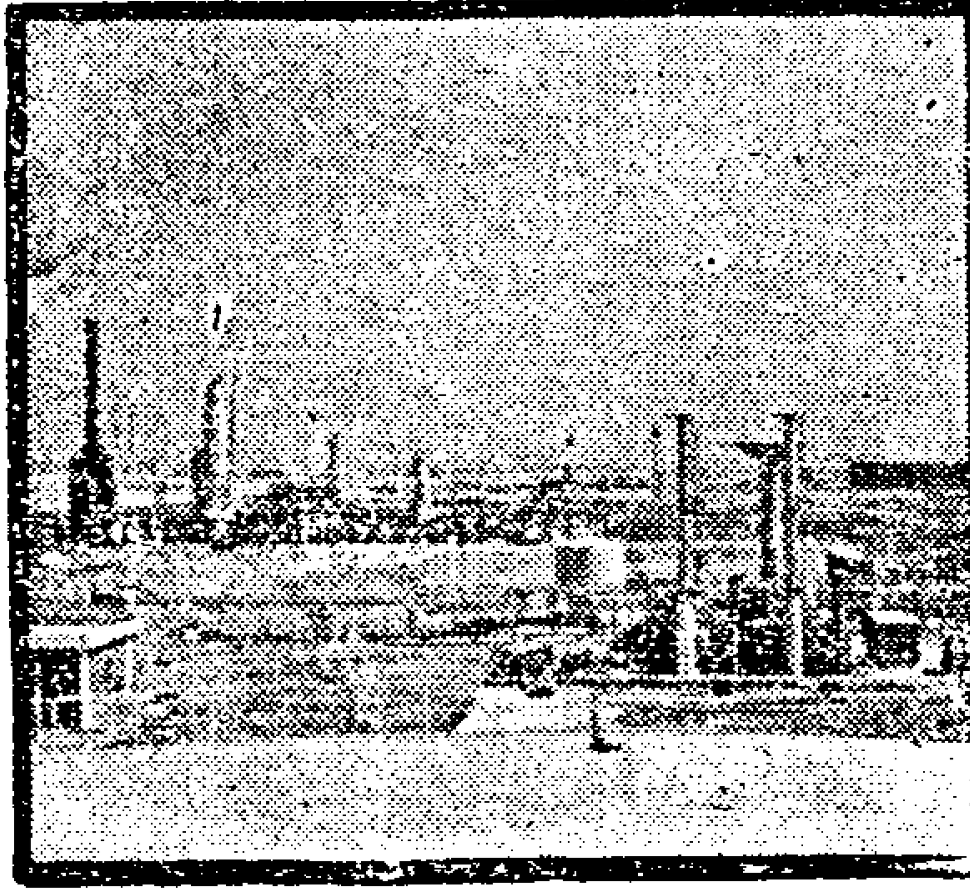
هذا وقد نفذت بتروجت بكفاءة العديد من المشروعات البترولية والصناعية فى جميع أنحاء مصر .. وتتمثل هذه المشروعات فى :

- إنشاء وحدات معامل التكرير والبتروكيماويات
- مد خطوط أنابيب الخام والغاز براً وبحراً
- إنشاء الخطوط والأرصفة البحرية والموانى
- بناء المستودعات رأسية وكروية لتخزين المواد البترولية
- مشروعات تدفيع الخام والغاز
- إقامة المدن السكنية سابقة التجهيز
- مشروعات الاتصالات اللاسلكية

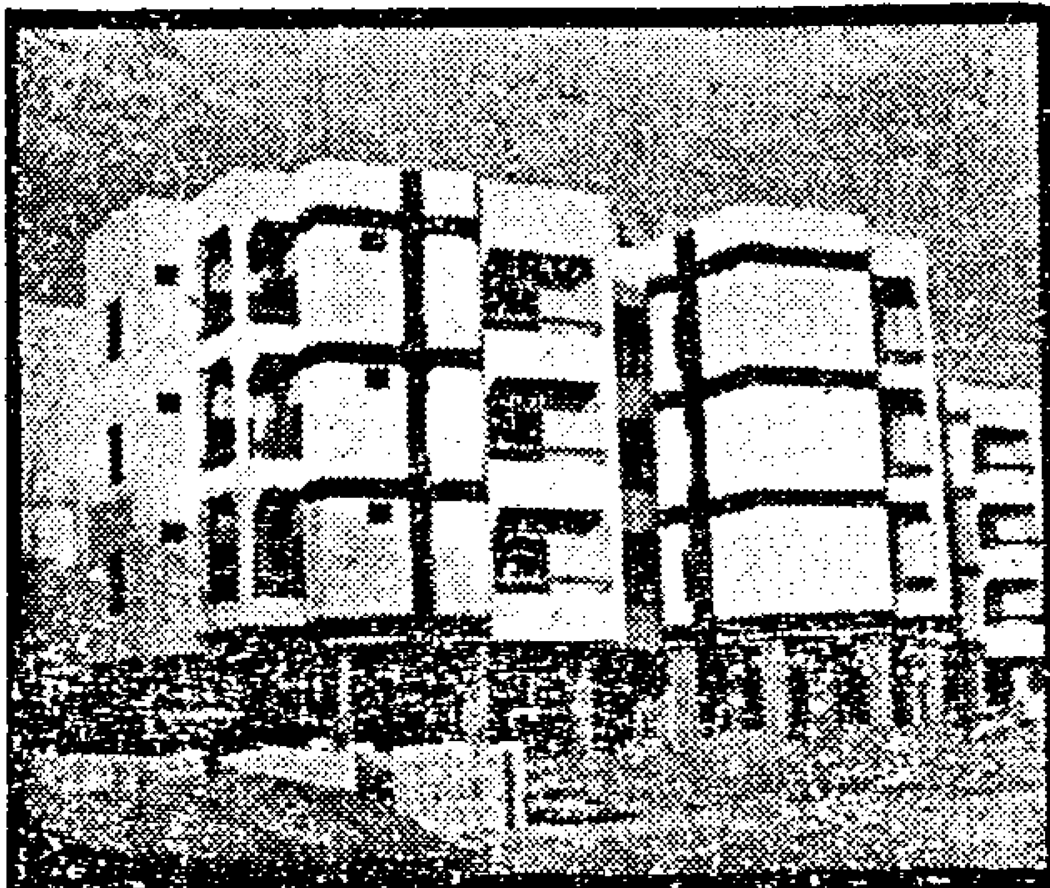
وهذا يؤكد قدرة **بتروجت** العالمية فى تنفيذ هذا الكم الكبير من المشروعات البترولية والصناعية بما تمتلكه بتروجت من أحدث المعدات وبأعلى مستوى من الأداء الفنى .. والإدارى .. والقيادى



بتروجت ١٢ أثناء تركيب المنصة البحرية مرجان ١٨٨



معمل تكرير بترول أسيوط



المبانى السكنية بمعمل أسيوط

شركة المشروعات البترولية والاستشارات الفنية - إحدى شركات الهيئة المصرية العامة للبترول

شارع جوزيف تيتو بالهايكستب - ص.ب ٢٠٤٨ الحرية/ هليوبوليس - تلكس 20343 PETJET UN رئيسى

ت : ٢٩٩٢٣٤٠ - ٢٩٩٢٣٤٣ - ٢٩٩٢٣٤٧ - ٢٩٩٢٣٥٠ - ٢٩٩٢٣٥١ " 92492 PETJET UN إحتياطى

شركة النصر لمنتجات الكاوتشوك



لأول مرة ينتج فى مصر

١ – بلاط أنتى أستاتيك من المطاط :

– ذات مقاومة كهربائية لا تقل عن ٥×١٠^{٤} أوم ولا تزيد عن ٥×١٠^{٨} أوم

– لا تتغير المقاومة بالاستخدام أو مرور الزمن

٢ – كاوتشوك بيوتيل :

– يستخدم فى أعمال العزل والتبطين

– للاساسات – الخزانات – البحيرات الصناعية – الترع – السدود

لكافة الاستعلامات : الادارة ٢٢ شارع سليمان الحلبى – القاهرة تليفون ٩١١٧٢٢/٩١٢٤٧٥ و٢٧ شارع الشهيد صلاح مصطفى – الإسكندرية تليفون ٤٩١٧٨٠١ – تلغرافيا : ناروبين – القاهرة

شركة مدينة نصر للاسكان والتعمير

احدى شركات وزارة الاسكان والمرافق

٤ شارع يوسف عباس مدينة نصر

* تبلغ مساحة اراضى المدينة الاصلية حوالى ٦٣٠٠ فدان .

* آلت الى الشركة مساحة اخرى قدرها ١٤٠٠٠ فدان .

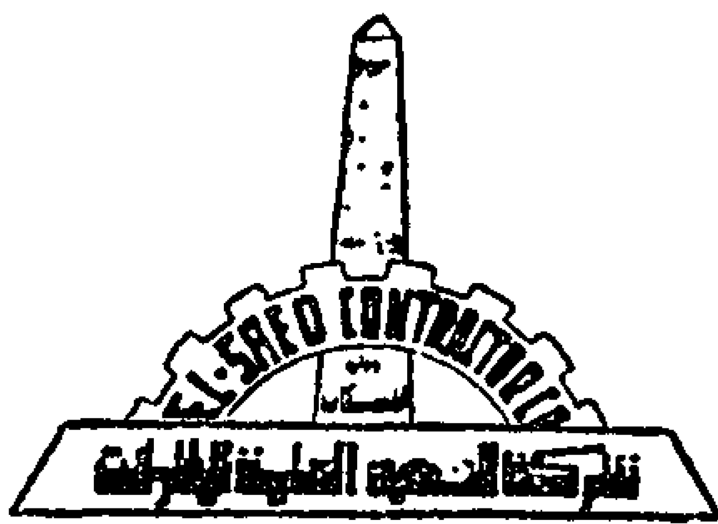
* يجرى تخطيطها بالتنسيق مع هيئة التخطيط العمرانى .

* بلغ رأس مال الشركة حتى الآن ١٠ مليون جنيه .

* يجرى العمل حاليا فى تنفيذ حوالى ١٧٩٠ وحدة شرق المنطقة السادسة بخلاف الاسواق بمناطق المدينة المختلفة باستثمارات تبلغ حوالى ٧ مليون جنيه .

* تقوم الشركة بتعمير اراضى المدينة ومدها بالمرافق من رصف وانارة ومياه وكهرباء وتسليم كل منطقة بعد الانتهاء من مرافقها الى حى مصر الجديدة .

* تعداد المدينة الان حوالى ١٠٠٠٠٠ نسمة وتستوعب المدينة حوالى ٢٥٠٠٠٠ نسمة .



شركة الصعيد العامة للمقاولات — EL.SAED co.

وزارة الاسكان

احدى شركات هيئة القطاع العام للتشييد

وزارة التعمير والاسكان

تعتبر شركة الصعيد العامة للمقاولات من اعرق شركات المقاولات فى جمهورية مصر العربية كذا الرائدة فى انتاج الزلط المتدرج آليا .

والشركة دائمة المساهمة فى تطوير الصناعة المصرية بالعمل فى مجال انشاء وتشييد المصانع والمطاحن الآلية والمخازن .

كما تعتبر الشركة الرائدة فى مجال انشاء وتعمير المدن الجديدة والاسكان بجميع انواعه المتوسط والاقتصادى – منخفض التكاليف – العمارات السكنية والفيلات والمكاتب والمستشفيات – الفنادق . المصارف المغطاة .

وعلى سبيل المثال لا الحصر :

مديرية أمن الاسماعيلية – عمارة النصر بالاسكندرية – الاسكان بالمدن الجديدة – مدينة الشروق بالهايكستب – القطامية – ٦ اكتوبر – العاشر من رمضان – العبور – السلام – مستشفى وجراج ومدارس وخدمات مدينة ١٥ مايو – مشاريع الصرف المغطى بسوهاج ودمنهور – مطحن بنها – مصنع الكوكاكولا بطلخا ومصنع المواسير بأجا .

هذا وتعتبر الشركة الأولى بجمهورية مصر العربية التى تقوم بانتاج الزلط المتدرج آليا بما تملكة من محطات ميكانيكية ثابتة لانتاج الزلط بمناطق اليهموم وفايد .

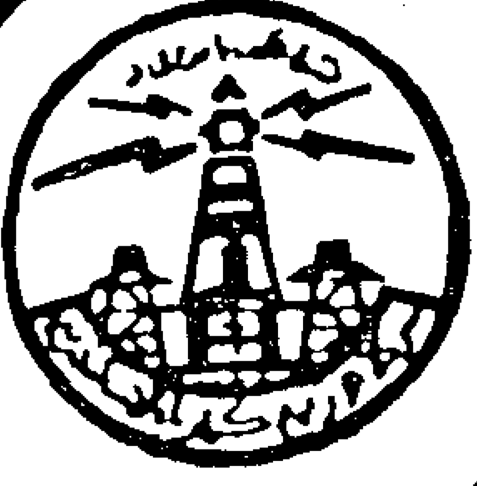
وللشركة ورش انتاجية لانتاج نجارة الابواب والشبابيك والدواليب والبلاط بجميع انواعه تغطى احتياجات الشركة فى جميع المشاريع التى تقوم بها .

وتضم الشركة مجموعة ضخمة من الخبرات والكفاءات فى جميع مجالات البناء والتشييد تحت رئاسة السيد / **المهندس عبد المنعم حسنى فهمى** رئيس مجلس الادارة .

مقاولات المبانى العامة – المصارف المغطاة – انتاج الزلط المتدرج آليا

الادارة العامة : ٥ ش ٢٦ يوليو – القاهرة – تليفون ٩١٦٢٧٧ – ٩٠١١٨٦ – ٩١٢٦١٧

تلغرافيا : صعيدلات . ص. ب بريد : محمد فريد – القاهرة . فاكسيميلى : ٩١٢٦١٧



شركة توزيع كهرباء الإسكندرية

إحدى شركات هيئة القطاع العام لتوزيع القوى الكهربائية بوزارة الكهرباء والطاقة

تفوز بدرع الإنتاج لعام ١٩٨٨/٨٧



السيد الدكتور / **عاطف صدقي** رئيس مجلس الوزراء

والسيد المهندس / **ماهر أباظة** وزير الكهرباء والطاقة

يسلمان درع الإنتاج

للسيد المهندس / **أحمد سمير أبو السعود** رئيس مجلس إدارة الشركة

فقد فازت الشركة بدرع الإنتاج عام ١٩٨٨/٨٧ عن جهودها في تنفيذ العديد من المشروعات الكهربائية التي أدت إلى رفع مستوى الخدمة وتلبية كافة الاحتياجات من الطاقة الكهربائية على مستوى محافظة الإسكندرية، والعاملون بالشركة يعاهدون

السيد الرئيس / **محمد حسني مبارك** رئيس الجمهورية

على الاستمرار في رفع مستوى الأداء وزيادة الإنتاج .


EGYPTAIR
مصر للطيران

الشركة الأهلية للصناعات المعدنية



تعتبر الشركة الاهلية للصناعات المعدنية أول الشركات التى ادخلت صناعة الحديد فى مصر حيث تأسست عام ١٩٤٦ وكانت تتكون من فرن واحد لانتاج الصلب من نوع الافران المفتوحة (سيمنز مارتن) بسعة ٢٢ طن بالاضافة الى وحدة درفلة تقوم بتشكيل الكتل المنتجة من ذلك الفرن لانتاج اسياخ حديد التسليح باقطاره المختلفة وزيدت على مراحل حتى بلغت ٣٦ طن/شحنة .

وفى عام ١٩٥٦ تم انشاء الفرن الثانى بسعة ٢٦ طن/شحنة وزيدت على مراحل الى أن بلغت الانتاجية للصلب المنتج بالشركة ٣٦ طن/شحنة .

وفى عام ١٩٦٠ تم انشاء وحدة درفلة ثانية لاستخدام المنتجات الوسيطة المتساقطة باوحدة الاولى خلال فترات اعطال خط التشطيب وذلك لانتاج اسياخ حديد التسليح ذات المقاسات الصغيرة .

ونظرا لزيادة الطلب واحتياج السوق المحلى لحديد التسليح لمواجهة التوسع العمرانى بالبلاد فقد تم انشاء وحدة الدرفلة الآلية على مساحة ٢١٠٠٠٠م٢ بطاقة انتاجية قدرها ٩٠٠٠٠ طن من حديد التسليح لتضيف طاقة انتاجية لمصنع الشركة الى نحو ١٧٠٠٠٠ طن سنويا من حديد التسليح بمختلف نوعياته واقطاره .

ولما كانت وحدة الدرفلة الآلية تعتمد فى توفير الخامات اللازمة لها عن طريق التوريدات المحلية من فائض انتاج شركة الحديد والصلب من الكتل بالاضافة الى الاستيراد من الخارج والذى كان يلتهم كل مخصص الشركة من النقد الاجنبى ولان الشركة متخصصة أساسا فى انتاج الصلب ولديها الخبرة الفنية العالية فى هذا المجال فقد انتهت أبحاث التطوير المستمرة بالشركة الى ضرورة القضاء على مشكلة توافر كتل الصلب لوحدات الدرفلة .

وقد انتهت هذه الدراسات الى ضرورة انشاء وحدة جديدة لانتاج الصلب عن طريق الافران الكهربائية وماكينات الصب المستمر للحصول على كتل الصلب عالية الجودة .

وبدأت الاجراءات التنفيذية لهذا المشروع الضخم من منتصف عام ١٩٨٣ وقامت الشركة بالبدء فى أعمال البنية الاساسية خلال فترة توريد المعدات وفى أقل من خمس سنوات انتهت جميع الاعمال المدنية والتركيبات المعدنية وتركيب المعدات وقد بدأت بالفعل فى الوقت الحالى تجارب التشغيل والانتاج بنجاح كبير لتكلل كافة الجهود المضنية التى بذلت فى السنوات السابقة ولتبدأ الشركة مرحلة جديدة من حياتها فى خدمة الاقتصاد القومى البلاد .

وتتكون وحدة الصلب الكهربائى والصب المستمر والذى بلغت تكاليفه حوالى ١٠٠ مليون جنيه وطاقته الانتاجية ١٦٠٠٠٠ طن سنويا من كتل الصلب بنوعياته ومقاساته المختلفة والذى تم انشاؤه على مساحة (٥٠٠٠ متر ٢) يتكون ذلك الصرح الضخم من ثلاث عنابر رئيسية :

(أ) عنبر الخردة .. حيث يتم تشوين وتجهيز وشحن الخردة فى السلات المخصصة .

(ب) عنبر الانتاج .. ويتكون من عدد ٢ فرن كهربائى باستخدام تكنولوجيا الصهر بالقوس الكهربائى وبسعة ٣٥ طن للفرن الواحد بالاضافة الى ماكينة صب مستمر

(ج) عنبر الخدمات .. ويحتوى على مجموعة المرافق والخدمات الخاصة بالوحدة وأهمها :

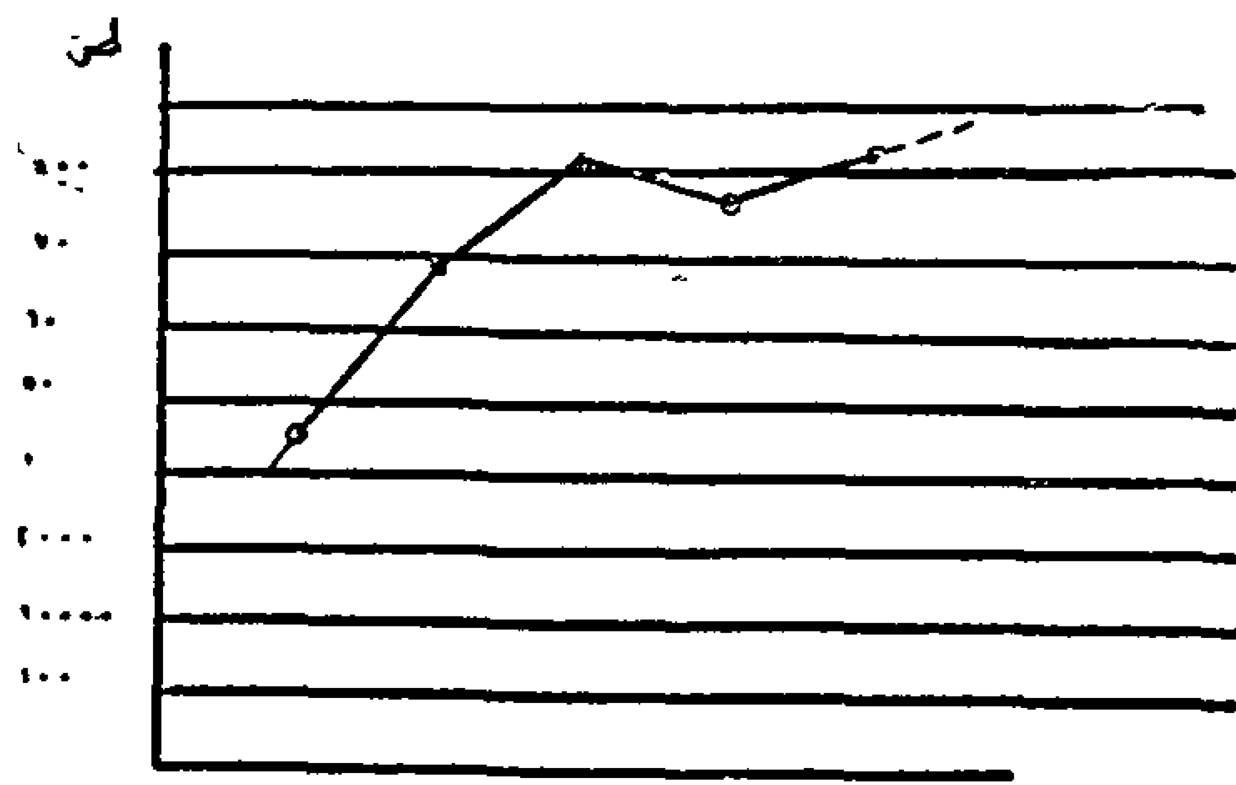
١ – مبنى الضواغط . ٢ – مبنى البوتاجاز .
٣ – محطة الاكسجين . ٤ – محطة الكهرباء .

أيضا فان أبحاث الشركة المستمرة فى مجال زيادة الانتاج تنظر بعين الاهتمام الى الوحدات المتقادمة بالشركة بهدف الاحلال والتجديد ومن هذا المنطلق بانه يجرى حاليا انشاء فرن ثالث من نظام الافران المفتوحة لانتاج الصلب بديلا عن الفرن الاول والذى انشىء فى بداية انشاء الشركة ويتم حاليا انهاء التركيبات وتوريد المعدات الخاصة به والذى اختير موقعه على امتداد عنبر الافران القديمة لضمان سهولة العمل والمناولة .

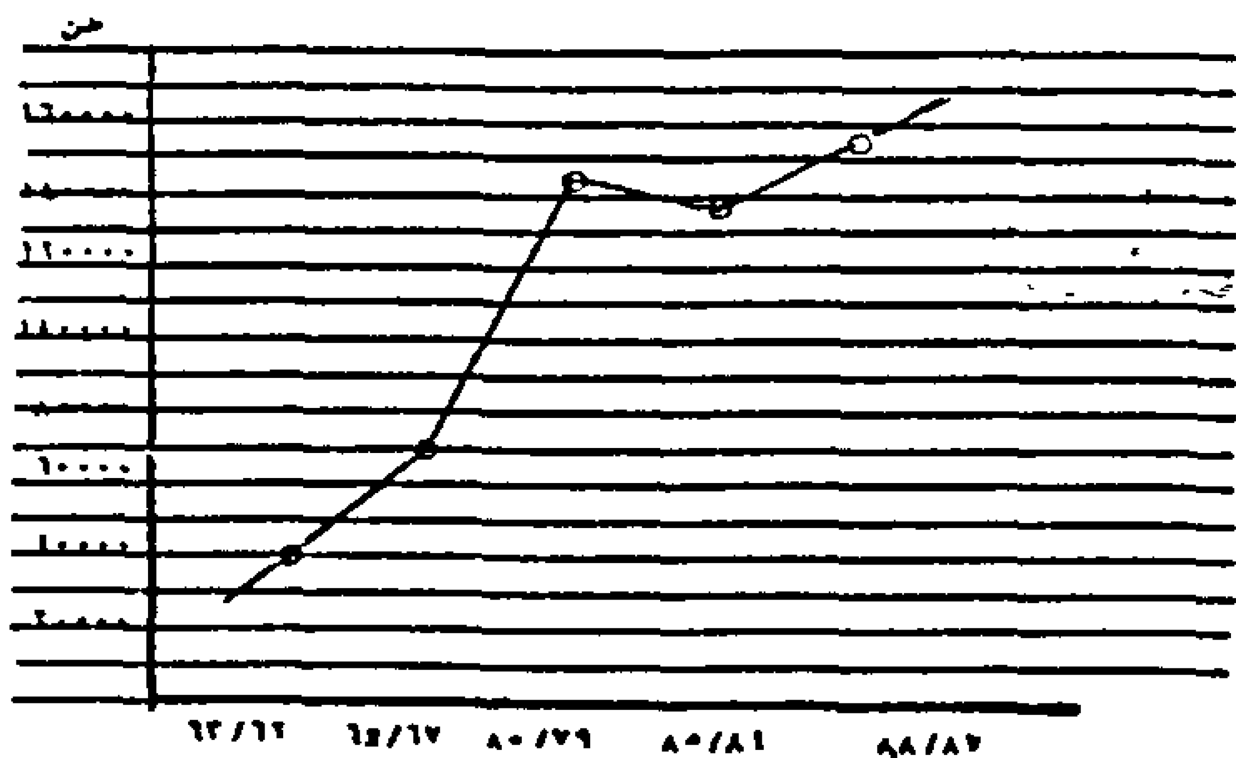
كذلك بأنه تجرى حاليا الدراسات الفنية لاعمال الاحلال والتجديد لوحدات الدرفلة جميعها للوصول بها الى طاقة انتاجية اجمالية قدرها (٣٠٠٠٠٠ طن) سنويا من حديد التسليح .

كذلك بأن الشركة تمتلك العديد من المعامل المجهزة بأحدث الاجهزة العلمية لاجراء كافة الاختبارات الكيمائية والميكانيكية على منتجاتها مما اكسبها ثقة المتخصصين فى مجال الانشاء وفى مجال النشاط الاجتماعى والصحى والرياضى للعاملين بالشركة فأن بالشركة قد أنشأت ناديا رياضيا به العديد من الملاعب الرياضية المختلفة للحفاظ على حيوية العاملين بالشركة وأسرهم كذلك فان الشركة لديها العديد من المبانى السكنية والشقق على معظم شواطىء ومصايف مصر وتوفرها بأجور رمزية للعاملين بالشركة وأسرهم لتجديد نشاطهم بعد العمل المضنى طوال العام .

هذا بخلاف توفير الرعاية الصحية للعاملين فى أكبر المستشفيات بمصر والخارج .



منحنى رقم (١) تطور انتاج الشركة من الصلب



منحنى رقم (٢) تطور انتاج الشركة من

شركة توزيع كهرباء شمال الصعيد

تطوير شبكات توزيع الكهرباء
وتشغيلها بأحدث الوسائل التكنولوجية لخدمة مليون مشترك

شركة توزيع كهرباء شمال الصعيد تقوم بنقل وتوزيع الطاقة الكهربائية على الجهود ١١٠٠٠/٤٠٠ فولت لخدمة خمس محافظات فى صعيد مصر .

انشأت شركة توزيع كهرباء شمال الصعيد فى يناير عام ١٩٧٩ ويتبعها خمسة محافظات هى : **الفيوم ــ بنى سويف ــ المنيا ــ أسيوط ــ الوادى الجديد .**

ويقع المقر الرئيسى للشركة بمدينة المنيا وينحصر نشاط الشركة فى الاعمال التالية :

* توزيع وبيع الطاقة الكهربائية .
* صيانة وتشغيل شبكات الجهد المتوسط والمنخفض داخل المدن والقرى .
* تنفيذ مشروعات تحسين الاداء والاحلال والتجديد .
* تنفيذ التوصيلات الكهربائية لجميع المشتركين ومشروعات الغير .

وفيما يلى بعض البيانات الاحصائية عن الشركة حتى ١٩٨٨/٦/٣٠ .

اجمالى عدد العاملين ٥٣٧٥ عاملا

* اجمالى أطوال خطوط وكابلات الجهد المتوسط (١١ ك ف) ٨٩٣٦ر٢٤٤ كم وبلغ أقصى حمل للشركة عام ٨٨/٨٧ (٢٩٠ر٣٧٧ ميجاوات) بينما بلغ أقصى حمل عند انشاء الشركة عام ١٩٧٩ (٨٠ ميجاوات) وبلغ عدد المشتركين حتى ١٩٨٨/٦/٣٠ (١١٣١٢٠٣ مشتركا) هذا وقد عملت الشركة على توفير احتياجات المواطنين بالمحافظات المختلفة فى مجالات الزراعة والرى والامن الغذائى والاسكان من الطاقة الكهربائية .

معدات حديثة لتقليل الأعطال الكهربائية :

وبفضل الجهود المخلصة فى تحسين الاداء واستعمال الاجهزة الحديثة فى تحديد اعطال الكابلات والخطوط وتدريب العاملين بفرق الصيانة امكن تخفيض النسب المئوية للاعطال .

وقد بلغ اجمالى الطاقة المباعة لعام ٨٨/٨٧ (٣ر١٥٦٦ مليون ك.و.س) .

هذا وقد صرح السيد المهندس / عبد السميع الزفتاوى رئيس مجلس ادارة الشركة بأنه جارى حاليا تنفيذ مشروعات تحسين اداء الشبكات القائمة بهدف الوصول بها الى أعلى مستوى من الكفاءة وتحسين الاداء وتقليل الفاقد والاعطال لخدمة الاغراض المختلفة بالمحافظات .

وذلك باستخدام أحدث الوسائل التكنولوجية من اجهزة لاسلكى ووقاية بهدف استقرار واستمرارية وتأمين التغذية الكهربائية للمواطنين وللمشروعات الانتاجية والزراعية ولاغراض الرى ومشروعات الامن الغذائى .

وأكد **المهندس عبد السميع الزفتاوى** رئيس مجلس الادارة بأن الشركة قدمت العديد من التيسيرات لخدمة المشتركين البالغ عددهم أكثر من مليون مشترك فى مجالات الكشف والتحصيل والقضاء على التراكمات التى طالما عانى منها جمهور المشتركين وذلك عن طريق استخدام الحاسبات الالكترونية فى تسجيل استهلاك المشتركين

م. ماهر أباظه
وزير الكهرباء

وقال ان الشركة تعطى أولوية مطلقة فى تلبية احتياجات المشتركين وخاصة مشروعات الامن الغذائى والصناعات البيئية والريفية فى الوقت والمكان المناسبين .

واضاف **المهندس عبد السميع الزفتاوى** ان الشركة فى نفس الوقت لا تنسى العاملين بها من ناحية رفع كفاءة ادائهم واطلاعهم على أحدث ما تأتى به التكنولوجيا العالمية فى مجال تحسين أداء شبكات توزيع الكهرباء سواء فى المدن أو القرى .

وقد قامت خطة التدريب بتغطية الاحتياجات التدريبية الفعلية للعاملين بالشركة واضعة فى اعتبارها الآتى :

- تنمية مهارات العمالة الفنية من مهندسين وفنيين .
- صقل العمالة التى يتكون منها العنصر التجارى بالشركة من رؤساء الايرادات والمفتشين والقراء والمحصلين بهدف تحسين معدلات الاداء تحقيقا للمهارات الفنية المدربة لتنفيذ الاعمال بالدقة والكفاية المطلوبة .

تحسين اداء الخطوط جهد ١١ ك.ف. :

واختتم المهندس **عبد السميع الزفتاوى** رئيس مجلس الادارة حديثه بأن اكد لتحسين الخدمة لجمهور المشتركين فان الشركة تقوم بتركيب سكاكين ومصهرات على التفريعات وتغيير بعض مقاطع الموصلات وتغيير العازلات التالفة كما تقوم الشركة أيضا بتغيير بعض كابلات البداية والنهاية بهدف تحسين أداء وتطوير خطوط كهرباء جهد ١١ ك.ف بالمحافظات الواقعة فى نطاق عمل الشركة ولتحسين معدلات الاعطال وتقليل نسبة الفقد فى الطاقة .

وقد تم اعداد دراسة بمعرفة المكاتب الاستشارية لتحسين اداء وتطوير عدد ٢٧ خطا ١١ ك.ف بمحافظة المنيا .. كما تم الانتهاء من اجراء دراسة شاملة والبدء فى تنفيذ وتطوير عدد ٢٦ خطا ١١ ك.ف بمحافظة الفيوم مع دراسة مصادر التغذية بالتعاون مع الشركة المصرية لهندسة النظم التابعة لقطاع الكهرباء تنفيذا لتوجيهات المهندس محمد ماهر أباظة وزير الكهرباء والطاقة .

Forging Industry

Is an infrastructure in the industrial countries, because it takes part in most industries' The Company contributes to this industry in many ways

I. Automotive industry

The forged part for :

a) Engine ·

— Crankshafts, connecting rods, cam-shafts, rocker arms inlet and exhaust valves.

b) Geer box :

All gears inside gear box, shifting forks levers shafts.

c) Under Carriage

Front and rear axels, wheel hubs, all joints of the propeller shaft, brake attachments,, steering mechanism, crown wheel and pinion for deferentials, and stub axle.

II. Railway Industry :

Buffers, drawhooks, sus- ... kinds of way wagons and which need high quality and precision

— Clips for fastening the rails to the sleepers

— Fish plates which join the rails together

III Hoisting and calibrated chains sieze from 6mm to 40 mm chaines are produced acc. to Din standards for housting and. track and cement industries

IV. Machine tools industry :

— We provide M/C tools industry with all required forged parts for manufacturing

— Centre lathes

— Miling M/C.

— Shaping M/C.

— Drilling M/C.

— Disc and hack saw

V Suez Canal and marine works :

We provide these industries with all their request of forged parts, as well as different kinds of chains ac- and under the approval of LLOCDS, from 6mm up to 40 mm. for hoisting purposes.

VI. Military Industry :

Ne provide all Military Factories with all their needs of forgings either free forged up to 1 ton/piece or die forged up to 100 kg piece

VII We have experts for dye design and large shop for executing the different types of dies for forging and sheet metal, shaping.

Also we have capacity for manufacturing spare parts for heavy machinaries.

IX We took shares in executing some National Projects such as rural electrification.

X We export our production to some European and Arab countries such as the Soviet Uion, Poland, France Kuwait. Su-

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It is clear from the above results that, on activation of Fayoum clay by 10% acid solution with a ratio of acid : clay equal to 1.5 : 1, the most active and stable dehydration catalyst among the other clays was produced. Such sample gives stable mole conversion equal to 75% of ethanol at 300°C and at space velocity of 0.5 hr^{-1}. (the thermodynamic feasible conversion is 71% for the ideal gas phase).

d. Effect of the sequence of activation.

The results of treatment of the three clays under different conditions are also represented in Fig. 9 which show that the Fayoum clay first activated by acid, then calcined gives the highest active and stable dehydration catalyst. So, it can concluded that, the Fayoum clay is the most active.

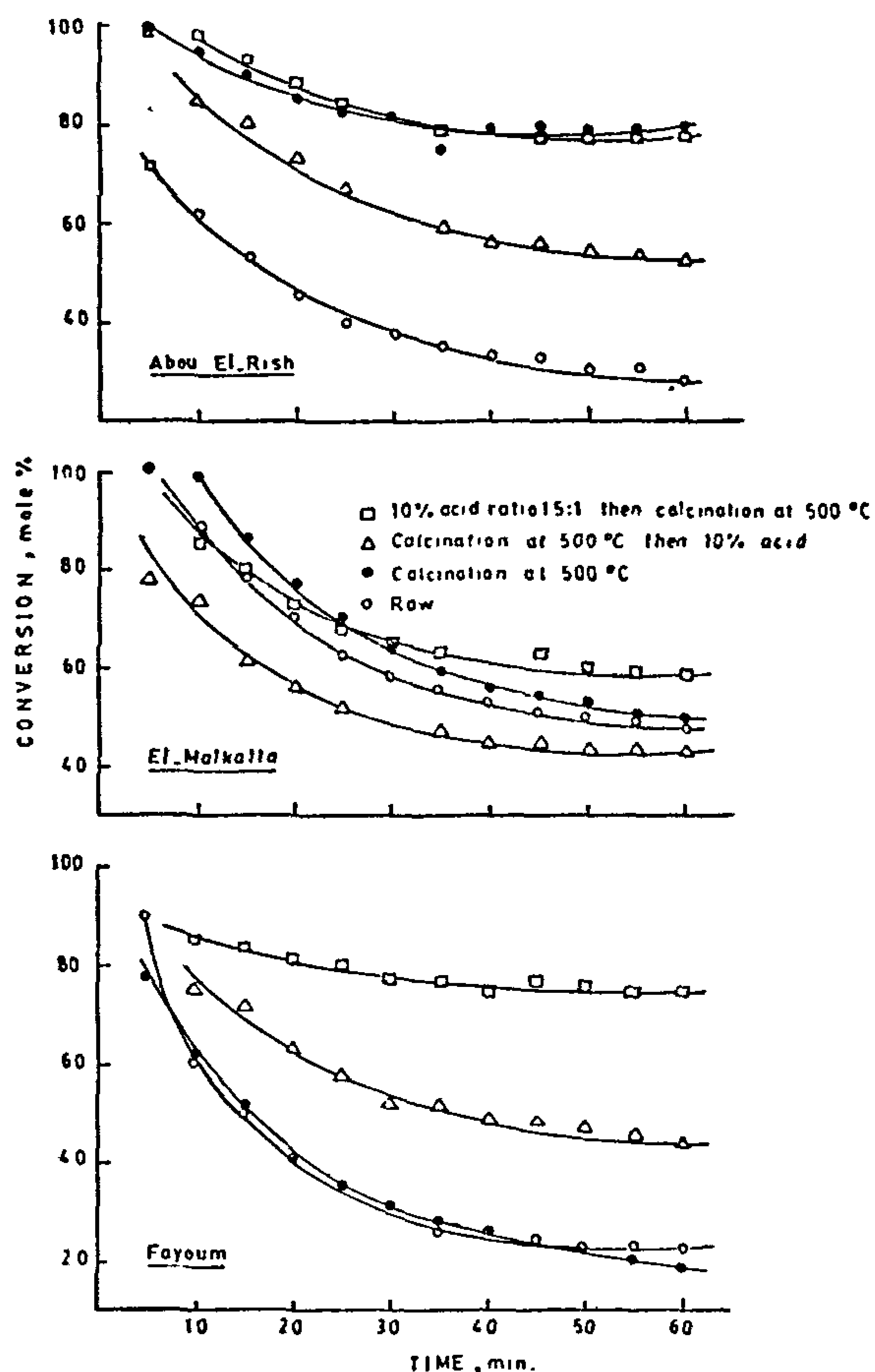


Fig. 9 Activity of clays of different treatment conditions.

CONCLUSION

From this study, it may concluded that :

1. On activation of clays by sulphric acid solution, the concentration of the acid should be less than 30%. Higher acid concentration ($>$ 30%) destroy the clay structure.

2. The optimum acidity is reached by using acid solution : clay ratio equal to 2:1 for the three clay samples. The acidity increases with increase of acid concentration up to 30%.

3. The clay activated with lower acid concentration (10%) is the most active clay towards dehydration of ethanol.

4. Optimum conditions of activation of Fayoum clay were found by treatment with 10% sulfuric acid solution at 104°C the acid solution : clay ratio = 1.5 : 1. then calcinated at 500°C. Such activated sample gives 100% conversion and selectivity at 400°C and space velocity 0.5 hr^{-1} (13).

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Figures, it is found that the conversion of ethanol is not affected by acid : clay ratio in case of El-Malkatta. In case of Abou El Rish, the conversion is more decreased by increase the acid solution : clay ratio from 1.5 : 1 to 2 : 1 but less decrease is observed from 2 : 1 to 3 : 1. In case of Fayoum, the conversion is much decreased by increasing the acid solution : clay ratio up to 3 : 1. The same picture is observed on using 20% acid solution (Fig. 8).

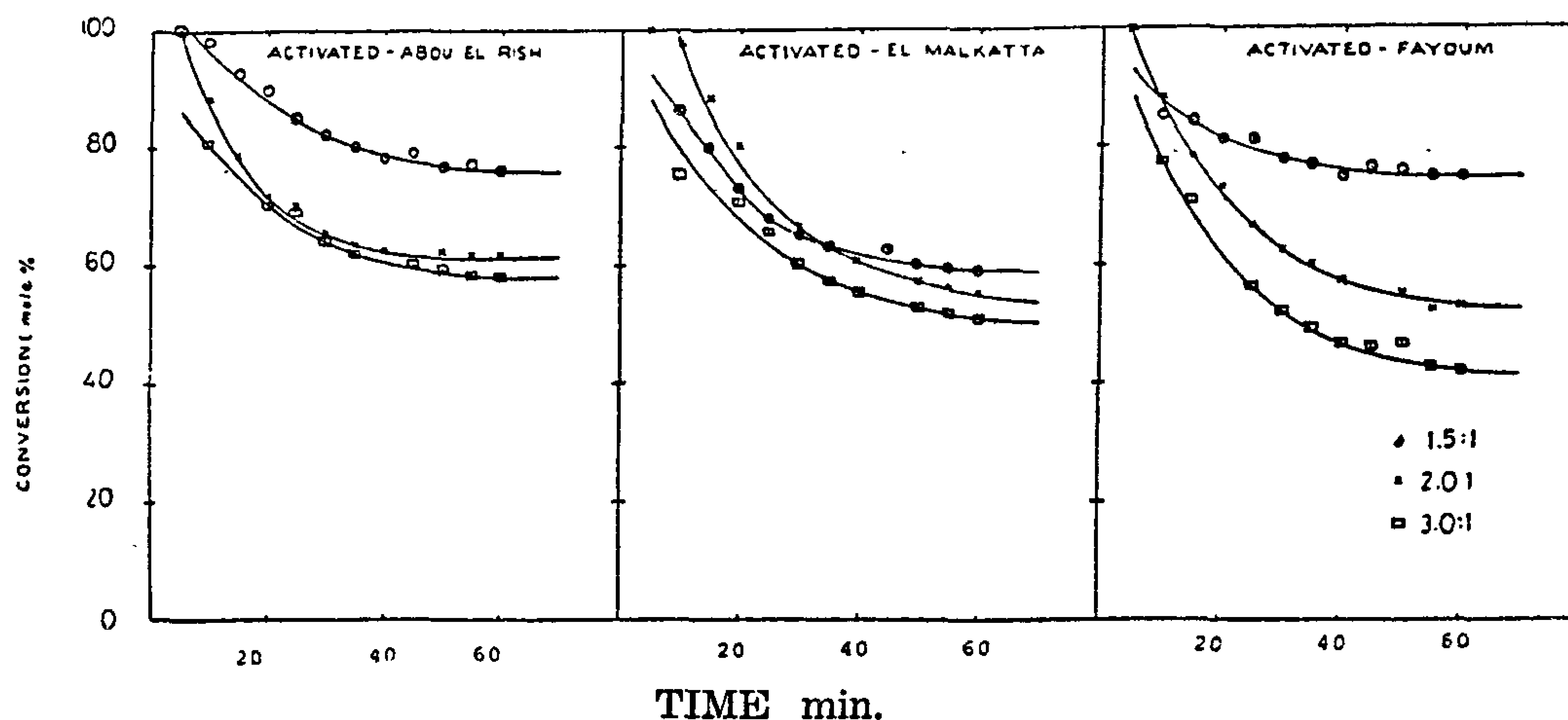


Fig. 7 Effect of acid : clay ratios on the catalytic of clays using 10% acid solution concentration

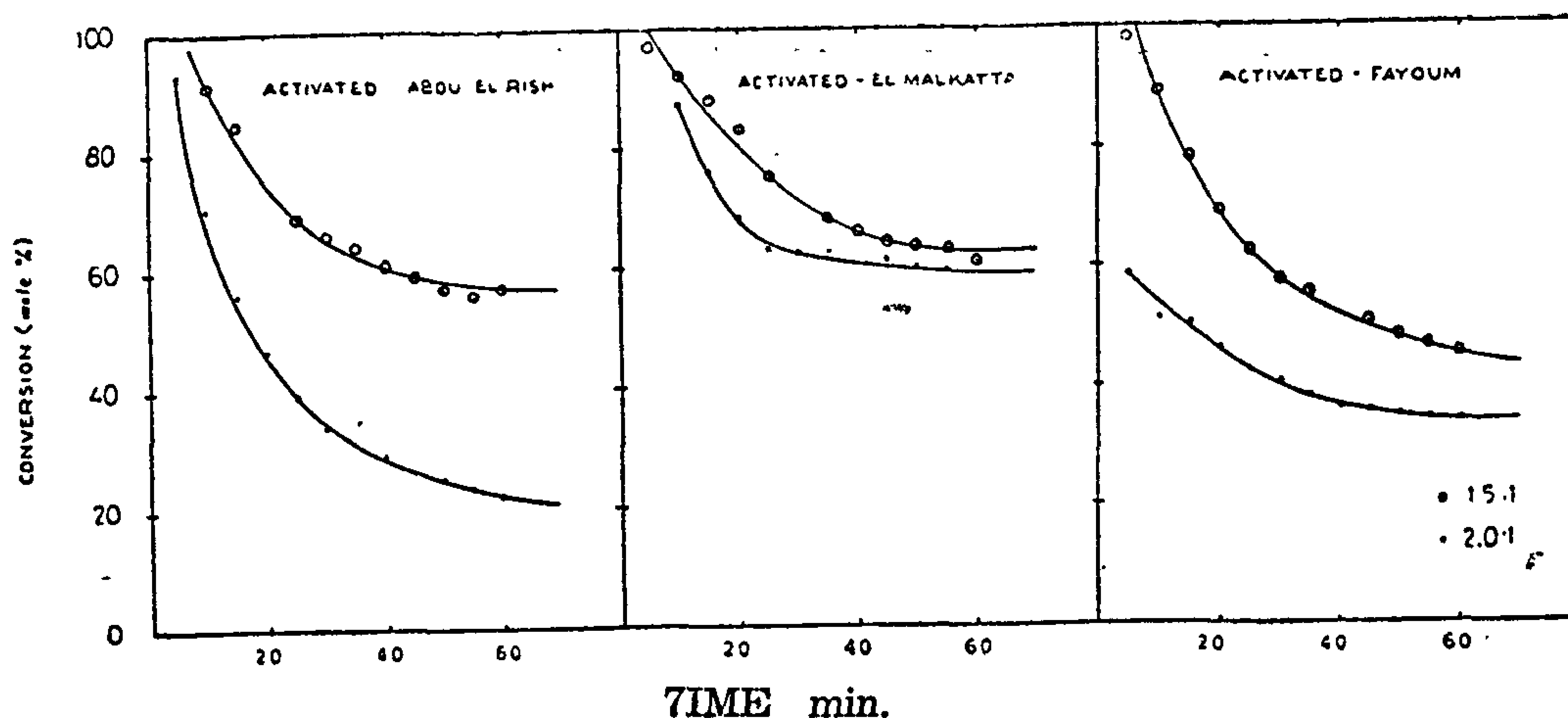


Fig. 8 Effect of acid : clay ratios on the catalytic activity of clays using 20% acid solution concentration

However, using 10% acid solution and acid solution : clay ratio 1.5 : 1 leads to higher and more or less stable activity of Fayoum clay. This means that the smaller amount of acid used and the more diluted solution the higher the activity of the clay.

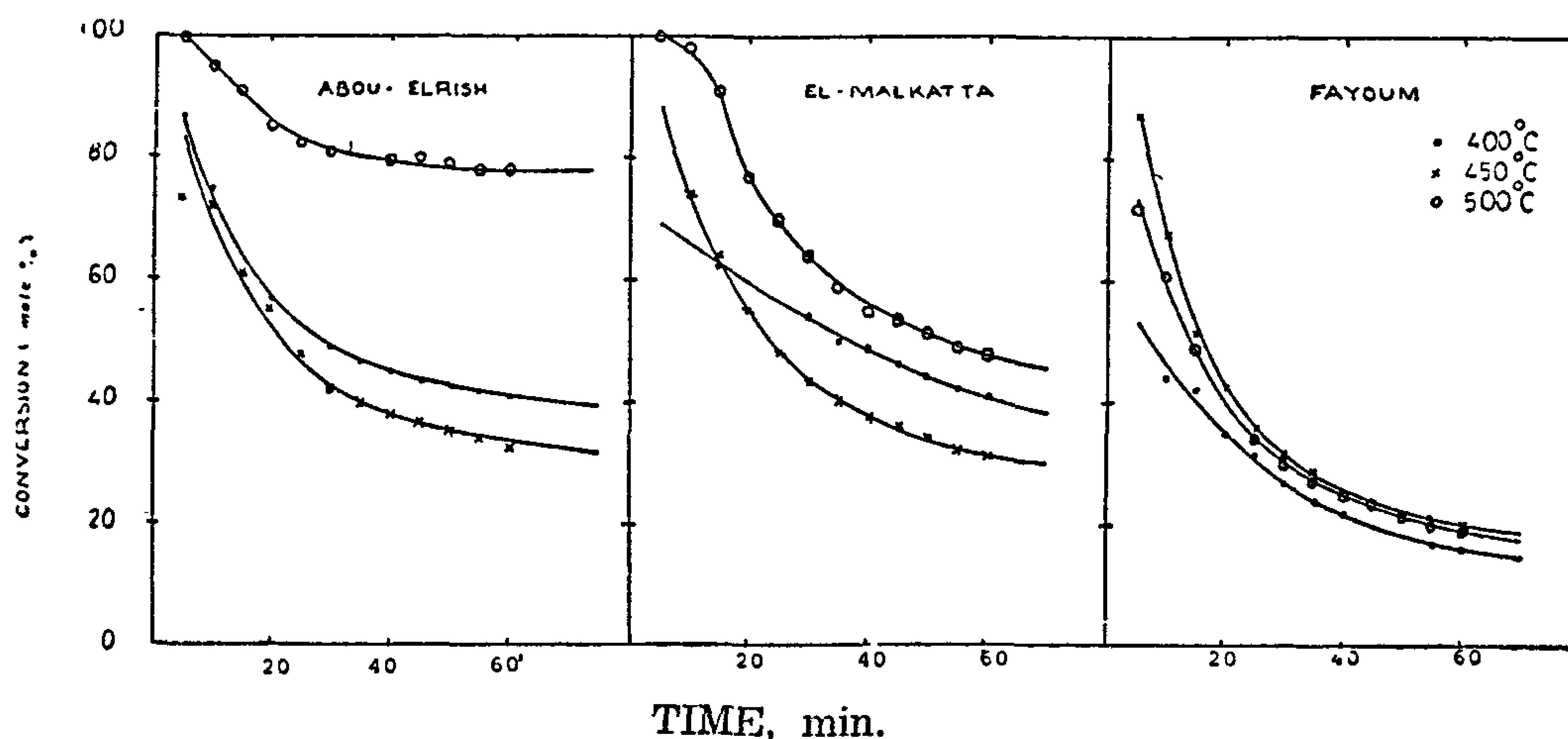


Fig. 5. Effect of calcination temperatures on the catalytic activity of raw clays

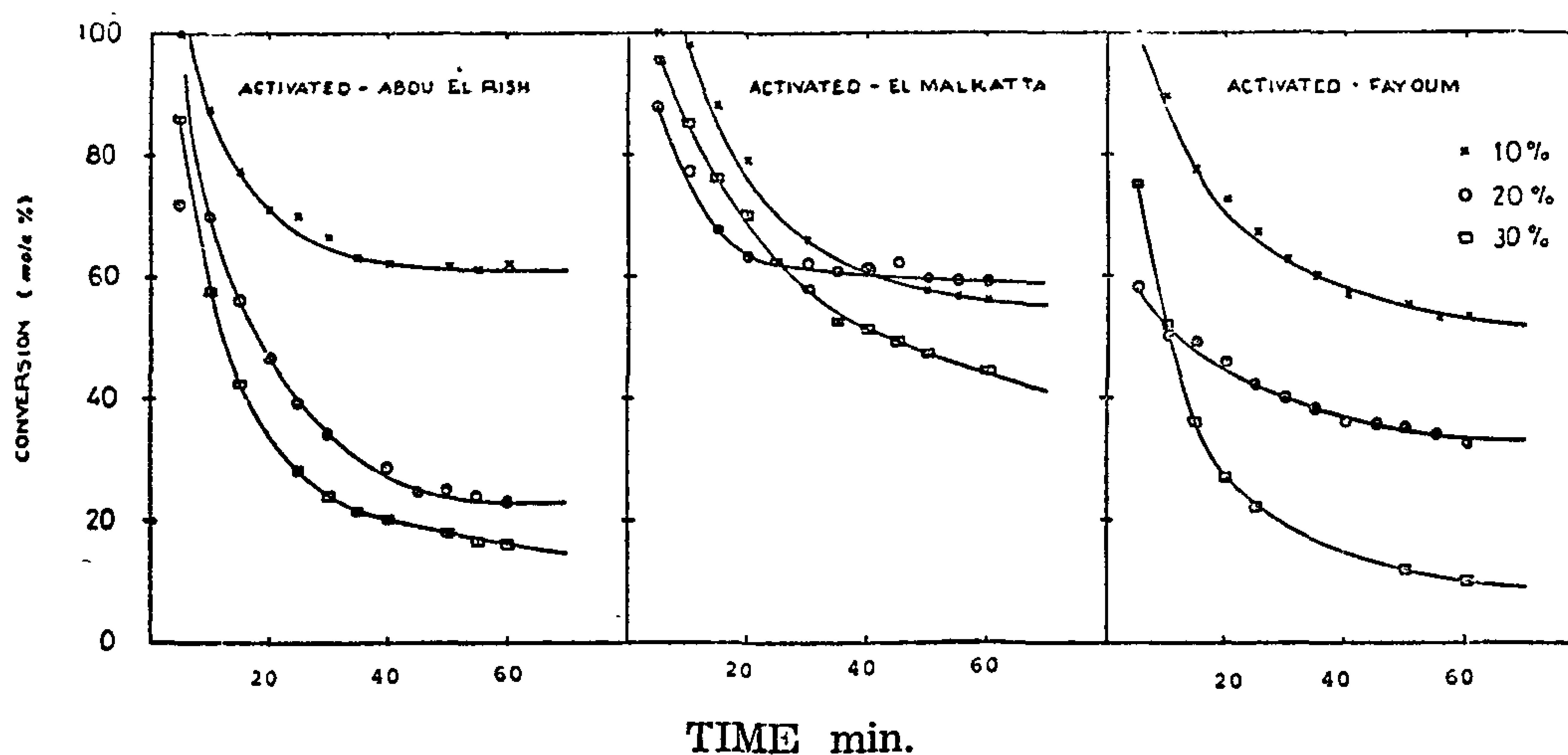


Fig. 6 Effect of acid concentration on the catalytic activity of clays
(acid : clay ratio 2 : 1)

In general, the results indicate clearly that the clay activated with lower acid concentration (10%) is the most active towards dehydration of ethanol. The higher concentration of acid destroy the clay structure (as indicated by X-ray diffraction) while low concentration such as 10%, is quite enough to extract undesirable amounts of iron and alkali metals and leach minimum amount of Al_2O_3 (as represented in Table 1). Such small leaching of Al_2O_3 leads to the unbalance of electrical charges in the clay lattice and formation of acid protons responsible for its high catalytic activity.

c. **Effect of acid : clay ratio upon clay activity.**

From the preceeding results, it was found that the 10% acid solution is the most suitable one. Data in Fig. 7 represent results of using 10% acid solution at different acid solution : clay ratios (1.5 : 1, 2 : 1 and 3 : 1). From these

Acidity of catalyst is an important factor for acid catalyzed reactions such as cracking, isomerization and dehydration The results in Table 3 show that the Fayoum raw clay possesses the highest acidity. Treatment of the three raw clays investigated in this work with 10% acid solution increases their acidity. The optimum acidity is reached on using acid solution: clay ratio equal to 2:1 for Abou El Rish and Fayoum clays, and is well expressed for the latter. The acidity increases with increase of acid concentration for the three clays with more or less limiting value with 30% acid solution, over which the clay structure is destroyed.

2. Testing of clays in dehydration of ethyl alcohol.

a) Effect of calcination temperature:

The three raw clay samples were calcined at three different temperatures, 400, 450 and 500°C. Each sample was then tested for dehydration of ethanol at reaction temperature 300°C and at space velocity of 0.5 hr^{-1}. From Fig. 5, it is clear that; by increasing the calcination temperatures up to 500°C, the conversion of ethanol to ethylene increases for Abou El Rish, El Malkatta while Fayoum clay has less response for calcination temperatures. The conversion decreases by time until it reaches constant value after 30 minutes. It is evident also that calcinated Abou El Rish clay at 500°C is the most active one.

b) Effect of acid concentration on activity.

To test the effect of acid treatment on catalytic activity, samples from the three clays activated with acid solution of different concentrations (10, 20 and 30%) using acid: clay ratio 2:1 were chosen. Figure 6 represents that the conversion of ethanol decreases by increasing the acid concentration from 10 % to 30% for the three clays. Abou El Rish, and Fayoum show the same picture, i.e. the conversion considerably increases with decreasing the acid concentration from 30%, to 10% but for El-Malkatta clay, the conversion slightly changes with acid concentration.

Table 3. Acidity of clay samples (meq/100 gm)

Activation condition	Abou El Rish	Fayoum	El Malkatta
Raw	61.31	99.04	61.31
10% acid			
1.5:1	77.12	81.94	72.30
2:1	85.52	197.98	61.77
3:1	67.48	106.40	67.48
20% acid			
2:1	114.00	236.72	85.53
30% acid			
2:1	207.00	237.67	123.55
50% acid			
2:1	234.00	197.98	114.04

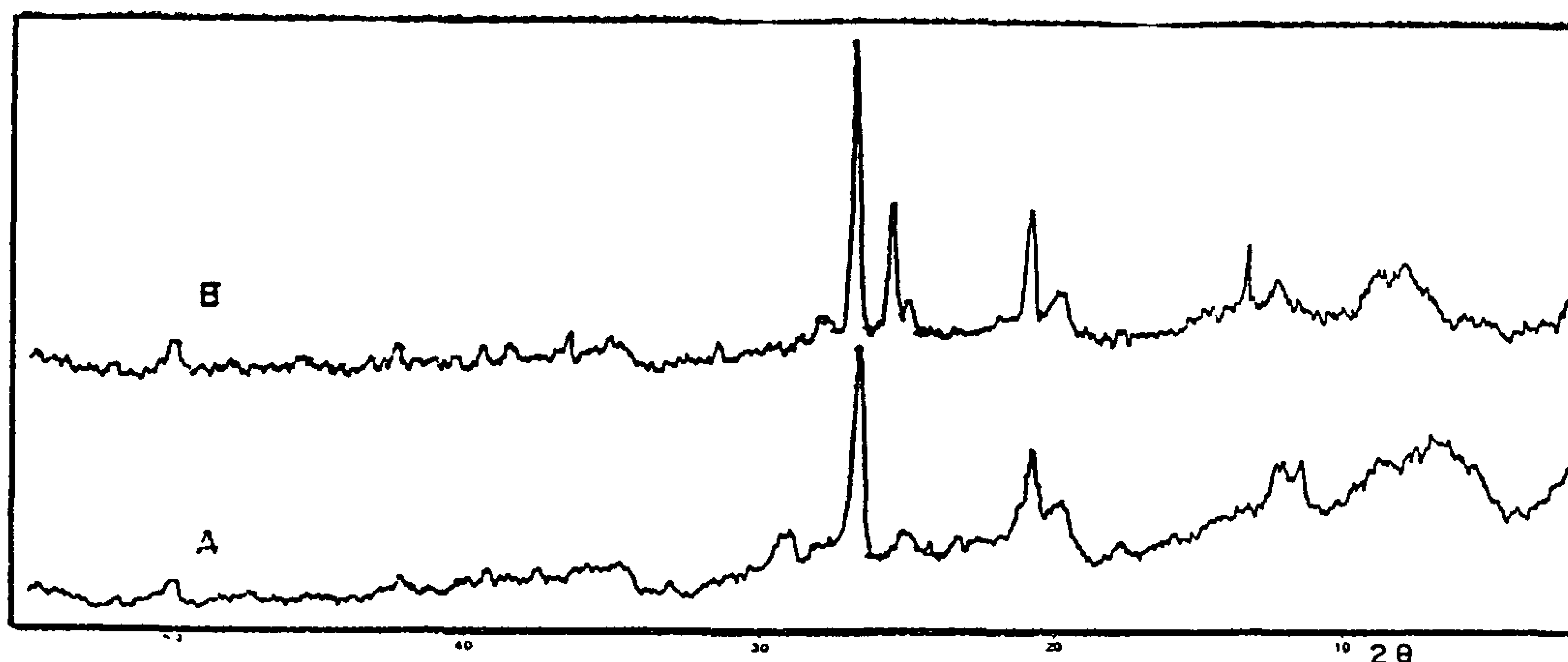


Fig. 4 (A): X-Rays Profiles of 10 % Acid Activated Fayoum clay.
(B): X-Rays Profiles of Raw Fayoum clay.

Date for surface area measurements indicate that, the increase in acid concentration results in a small increase in surface area which is true also for acid: clay ratio (Table 2). The increase in surface area, however, reaches an optimum at an acid concentration of 20% for both Fayoum and Abou El Rish. At higher concentrations, the surface area values decreases. Increase of surface area may be due to leaching of Al_2O_3, Fe_2 O_3, alkali metals and oxidation of organic matters by H_2 SO_4 leaving in their places porous gaps. Higher concentration of the acid destroys the clay structure (as indicated by DTA and X-ray) which leads to decrease of its surface area. Such optimum is not observed for El Malkatta clay. This may be due to its resistant structure, as it contains small amounts of iron, alkali metal and organic compounds as compared with the other two clays (Fayoum and Abou El Rish clays).

Table 2. Surface area (m^2/gm) of raw and treated clays.

Activation condition		Abou El Rish	Fayoum	El Malkatta
Raw		6.49	7.10	5.23
10% acid solution				
acid:clay ratio	1.5:1	16.99	38.40	7.13
	2:1	19.00	51.00	11.60
	3:1	17.66	66.09	10.48
20% acid solution				
acid:clay ratio	1.5:1	23.44	46.55	13.37
	2:1	21.70	52.45	13.95
	3:1	56.20	67.00	14.00
30% acid solution				
acid:clay ratio	1.5:1	22.05	41.73	8.59
	2:1	23.40	44.14	13.50
	3:1	22.30	51.45	17.01
50% acid solution				
acid:clay ratio	2:1	22.32	31.02	18.10
	3:1	22.21	35.06	18.96

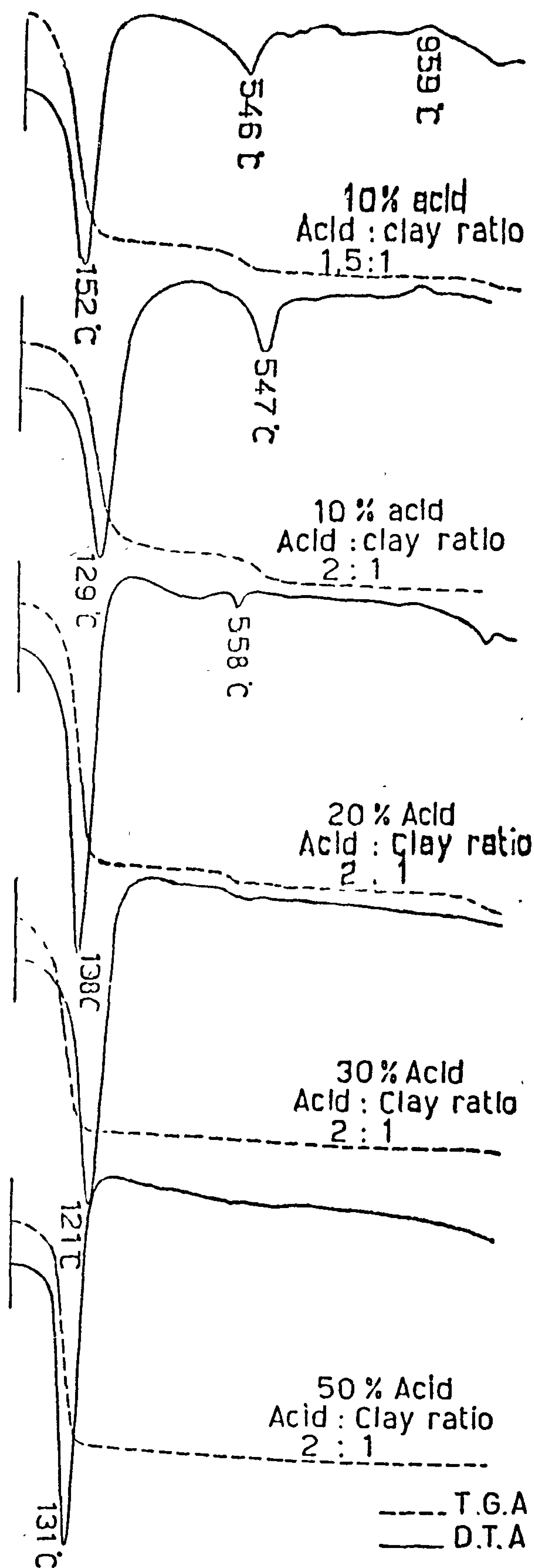


Fig. 2. Differential thermal analysis profiles of 10%, 20%, 30% and 50% acid activated fayoum clay.

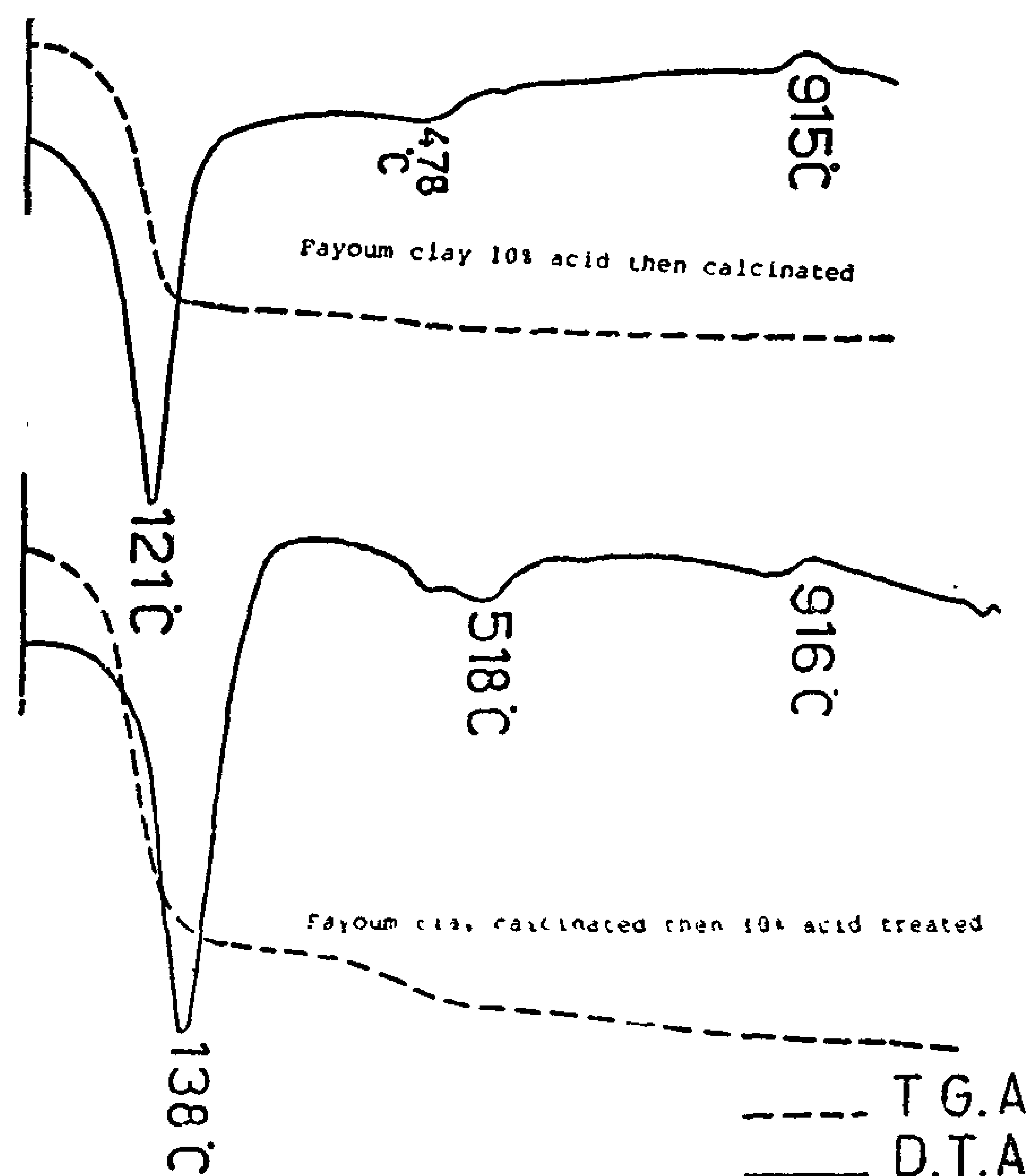


Fig. 3. Differential thremal analysis profiles of Fayoum clay calcined then acid treated and acid treated then calcined.

From X-ray diffraction patterns, Fig. 4, the characteristiic spacing d(A°) and the relative intensities I/I_o for the examined samples, indicated that the raw clays are mainly kaolinites containing a considerable amount of free silica which is in accordance with DTA and chemical analysis.

Increasing the acid solution concentration up to 30%, the X-ray diffraction patterns show the same specific diffraction lines as the raw clays. However, the intensties of some lines decrease as result of the lower cation density. Further increasing of the acid concentration up to 50%, the characteristis «d» spacing of kaolinite at ~7.12 disappeared which is related to the destruction of the clay lattice as also indicated by the differential thermal analysis.

Analysis of the raw clay shows that it is a kaolinite. After treatment with acid, the SiO_2/Al_2O_3 increases, the amount of iron and alkali metals decrease. Loss on ignition sharply decreases which is an advantage of using H_2SO_4 instead of HCl for activation of clays[11].

Differential thermal behaviour are represented in Figures 1-3. DTA curves, Fig. 1 for Abou El Rish, El Malkatta and Fayoum raw clays indicate that in all cases an endothermic peak is exhibited at 120-140°C accompanied with loss of weight which represent surface water adsorption capacity of clay. According to Zulfugarov et al[12] the catalytic activity of clays is directly propertional to the amount of water physically adsorbed on the surface of the clay, represented by the first endothermic effect at about 100-150°C. Another endothermic peak at 550-600°C accompanied also by loss of weight (TGA line) represent lattice destruction and the escape of structural water. An exothermic peak at ~ 920-968°C without change of weight, indicate the complete alteration of the structure and phase transformation into mullite at these temperatures. Such DTA pictures of the clays indicate that they are mainly kaolinite.

From DTA profiles, Fig. 2, for acid activated Fayoum clay it is seen that increase of the ratio of 10% acid solution to clay does not affect the structure of the clay. Increase of acid solution concentration begins to change the structure of the clay at 20% acid solution, as seen from the decrease in the endothermic peak at 547°C (10% acid solution) corresponding to crystal water and which is shifted to 558°C (20% acid solution). The kaolinitic exothermic peak at 959°C is hardly detected. Increase of acid concentration to 30% and 50% leads to complete destruction of the clay as seen from the disappearance of the second endothermic and the last exothermic peaks found in the raw clay.

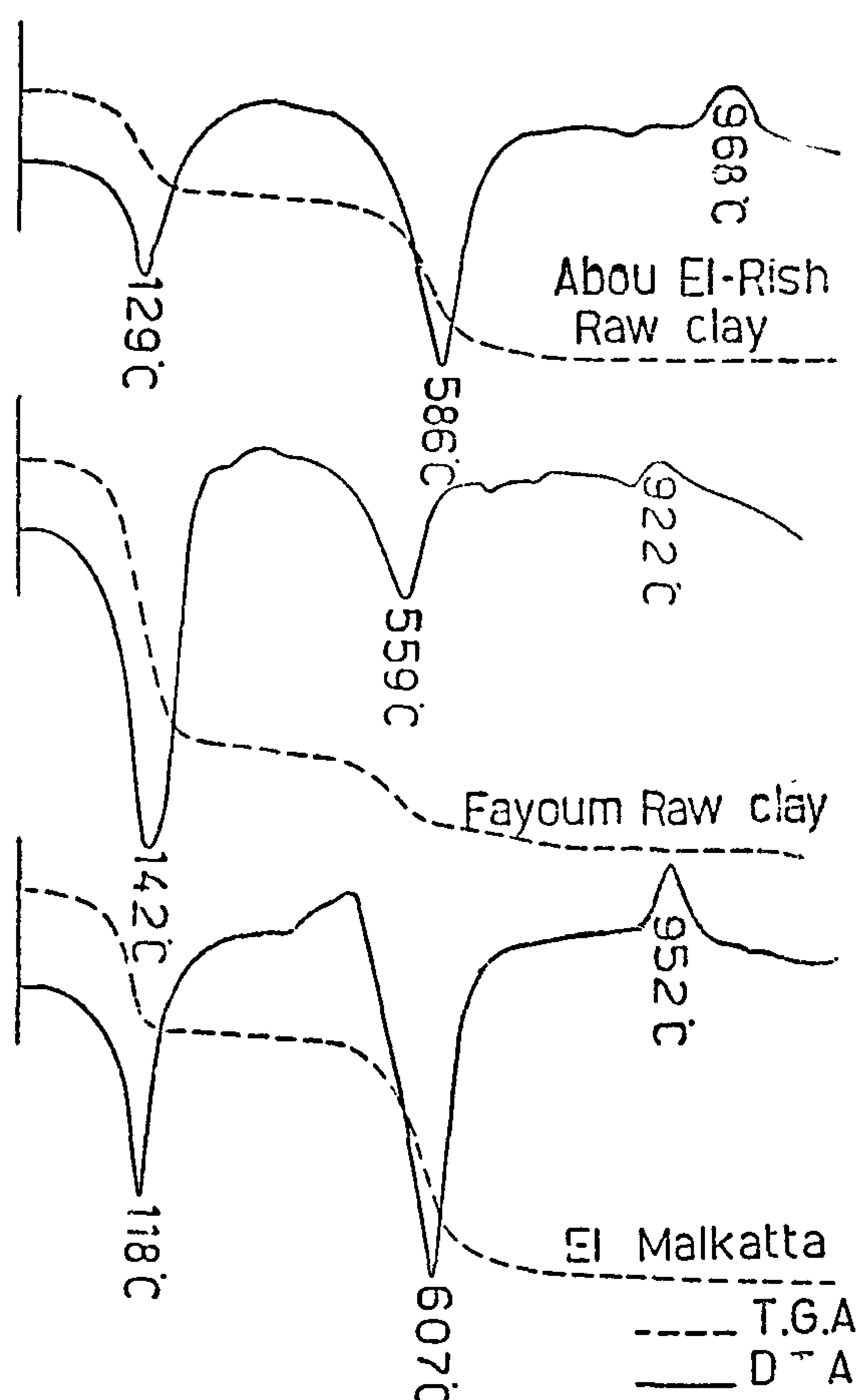


Fig. 1. Differential thermal analysis profiles of Abou El-Rish, Fayoum and El-Malkatta raw clays.

DTA thermograms, Fig. 3, show the effect of chemical and thermal activation. These thermograms show some changes in the structure of the sample firstly acid activated, mainly due to loss of structural water as indicated by the small weight loss and the diffused endothermic peak at ~ 518°C. The adsorption capacity of water is also lower as indicated by the endothermic effects at 118°C. Exothermic effects at 915 and 916°C remains the same for both cases.

EXPERIMENTAL

1. Study of physicochemical properties of clays.

Three clay samples from three different regions (Abou El Kish, El Malkatta and Fayoum) were selected, grounded and sieved to mesh size less than 100 mesh and then subjected to activation either physically, chemically, or physico-chemically. Physical activation carried out by subjecting the clay samples to calcination in the presence of dry air at temperatures 400 to 500°C for 4 hours. Chemical activation carried out by refluxing the fine samples with different concentration of sulphuric acid solution (10, 20, 30 and 50% acid solutions) for 6 hours at 104°C, and different acid solution: caly ratio (by wt) varying from 1.5 : 1 to 2 : 1, and 3 : 1.

Physico-chemical activation, was studied by subjecting the clays samples to thermal followed by chemical treatment or by the reverse of this sequence.

In order to get a general picture of the changes that occurred as a result of treatment, the treated materials have studied by different techniques; differential thermal analysis and thermogravimetric analysis to trace the structural changes accompanying the previous treatments. In addition, X-ray analysis (diffraction and fluorescence) were also carried out to study the crystalline structure and its chemical composition. The surface area of samples were also measured by dynamic BET[9,10].

Acidity was measured by stirring the clay sample with 0.1 N solution of KOH, decantation and then back titration of the excess alkaline with 0.1 N solution of HCl using phenolphthaline indicator.

2. Catalyst activity testing.

The dehydration of ethyl alcohol, was carried out at different temperatures in the range of 300-500°C and space velocity of 0.5 hr^{-1} using a bench scale flow system under atmospheric pressure. The selected samples used as catalysts, was in the pellet form.

Gas products were analysed by gas chromatography using Perkin Elmer Chromatograph model Sigma 3B, and column packed with 15% silicon oil on chromosorb W.

From the gas chromatographic analysis data, it was found that the gaseous product was mainly ethylene.

RESULTS AND DISCUSSION

1. Structural changes.

The results of chemical analysis of Fayoum raw and activated one (by 10% acid : clay ratio 1.5 : 1 by wt) are presented in Table 1 .

Table 1. Chemical analysis of Fayoum clay, wt%

	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	Cl	Ignition loss	Total
raw-clay	56.91	16.08	6.93	4.65	1.87	1.32	1.20	0.09	11.15	100.2
Activated form	72.79	15.18	4.87	1.19	0.47	1.13	0.34	0.00	4.05	100.02

PRODUCTION OF ETHYLENE FROM LOCAL SOURCES FOR PETROCHEMICAL INDUSTRY

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ABSTRACT

Egypt is starting now its petrochemical industry by the production of PVC. The starting material "Ethylene" is imported from abroad. This is accompanied by many difficulties concerned with hard currency needed and shipping troubles. The yearly needed amount of ethylene can be produced by catalytic dehydration of the annual surplus of the cheap ethyl alcohol produced from our local sugar cane and starch industries.

As long as Egypt is rich with natural clays, they can be used as cheap dehydration local catalysts instead of imported synthetic catalysts. Ethylene production by dehydration of ethyl alcohol is of higher purity and lower costs than that produced from petroleum source. Representative samples from the main local clay deposits (Fayoum, El-Malkatta and Abou El-Rich) were investigated for this purpose in the raw and activated forms. Activation included either, thermal activation by calcination of the clay in stream of dry air at different temperatures; or chemical one by treatment with different concentrations of sulphuric acid solutions or both of the two processes in different sequences.

Dehydration activity of the prepared clay catalysts was investigated, by using absolute and technical ethyl alcohol produced from our cane sugar industry, in a fixed bed flow system.

Among the studied raw clays Abou El-Rich clay was found to be the most active one. However, after activation of the three clays, Fayoum clay, showed very high activity. The optimum conditions of activation were found by treatment of Fayoum clay with 10% sulphuric acid solution at 104°C; the acid solution: clay ratio = 1.5 : 1, then calcination at 500°C. Such activated sample gives 100% conversion and selectivity at 400°C and space velocity 0.5 hr^{-1}.

INTRODUCTION

Ethylene is an essential raw material for petrochemical industry. It is produced from gaseous and liquid petroleum fractions by complicated thermal and catalytic processes. In addition, ethylene can be easily and selectively produced yy catalytic dehydration of ethyl alcohol.

Our country is very rich in sugar cane which grows every year in amounts. Together with sugar as result of the industry of sugar cane, rectified ethyl alcohol is also produced in excess amounts than that needed for usual local consumption. Meantime Egypt, have many localities rich in natural clays, it is thought to test these local clays as dehydration catalysts for the production of the needed amount of ethyiene for our PVC industry from the annual surplus of ethyl alcohol.

Local clays may replace the expensive catalysts employed for catalytic dehydration of ethyl alcohol(1-8).

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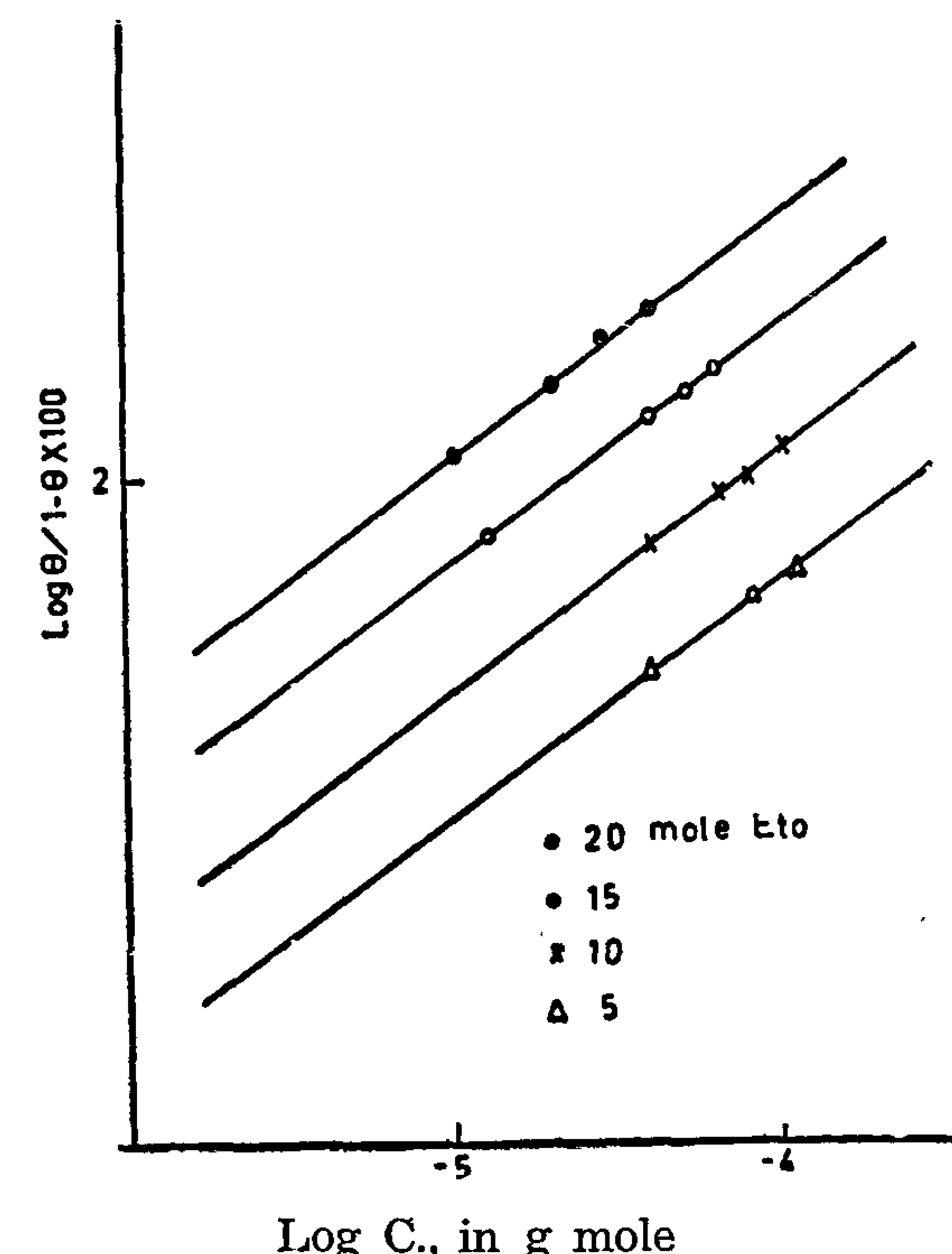
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nics on the corrosion of steel in 0.05 N HCl was next studied. Table 2 shows that maximum inhibition is declarated at this concentration.

Table 2: Effect of the Critical Micelle Concentration on Percentage Inhibition.

	No. of Ethylene oxide Moles in nonionic	CMC g/mol/L	Max. PI
Naphthenic acid +	5	119 x 10^{-6}	40
	10	78 x 10^{-6}	58
	15	58 x 10^{-6}	70
	20	46 x 10^{-6}	79
Naphthenyl alcohol +	5	123 x 10^{-6}	60
	10	80 x 10^{-6}	66
	15	59 x 10^{-6}	73
	20	47 x 10^{-6}	80



Log C., in g mole
Fig. 3 Langmuir Isotherm Relation

Comparative studies between the polyethoxylate naphtheenic alcohols with various number of ethylene oxide moles (5-20) and the corresponding polyethoxylated naphthenic acids having the same number of ethylene oxide moles (15) indicate that, in all cases the former nonionics are more efficient than the latter Table 2. This may be explained on the probability that the functional groups OH and CooH play a role in anchoring to the metal surface.

Langmuir deduced that the fractional surface (θ) covered by adsorption is related to the concentration (19-21).

Double logarithmic plots of concentration C vs. $\theta / 1-\theta$ x 100, for convenience for the nonionic are shown in Figure 3. Shtraight lines are obtained and are nearly paraalaled for all the tested compounds. These straight lines indicaate that the data obtained confirm with Langmuir adsorption isotherms.

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yield. The IR spectra of the alcohol shows the OH stretching frequency at 3500-3530 cm^{-1}. Figure 1 shows the rate of ethoxylation of naphthenic alcohol. From this figure it is found that the reaction rate is faster than that found for the coresponding naphthenic acid (13).

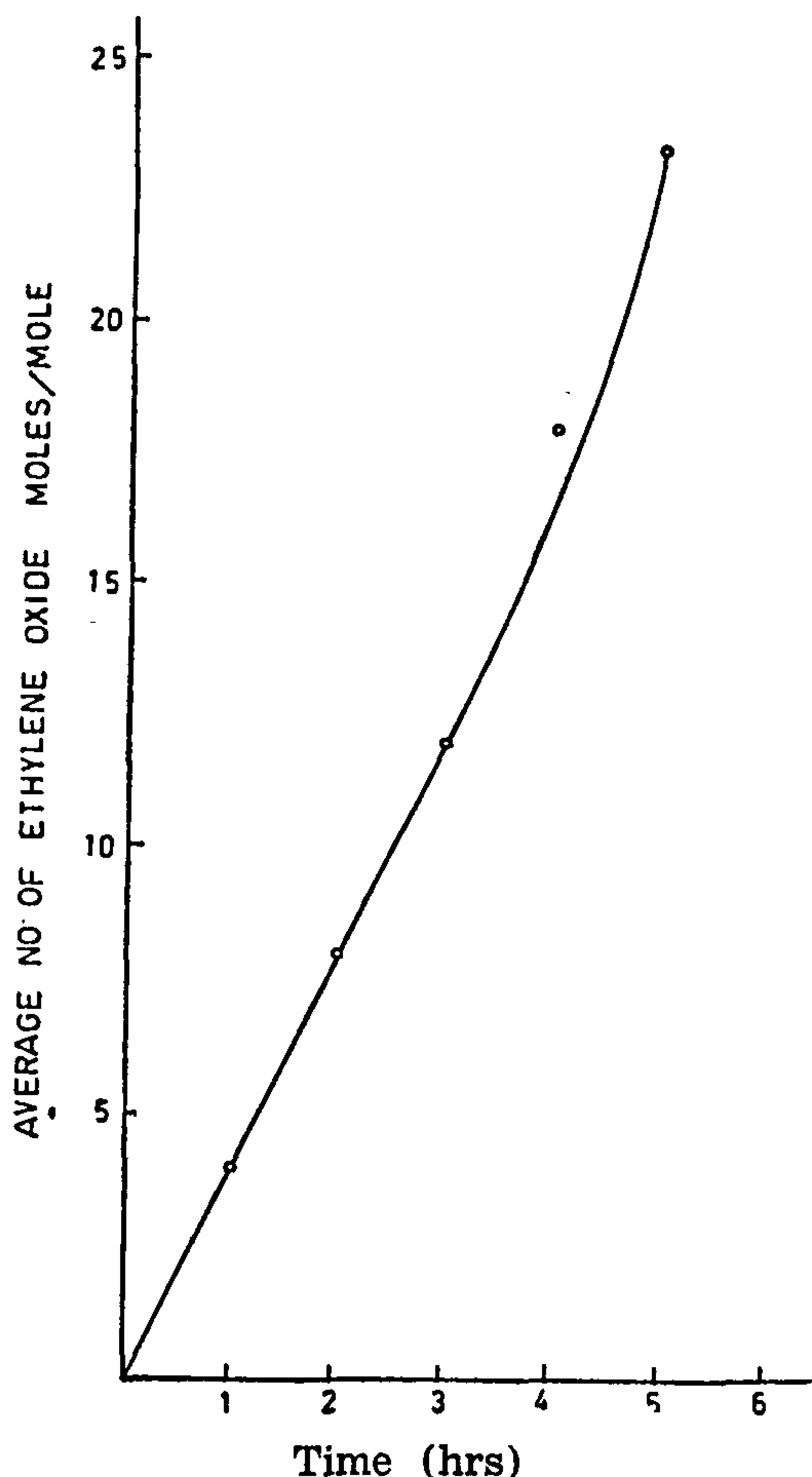


Fig. 1 Rate Ethoxylation of Naphthenic Alcohol.

Figure 2 shows the influence of concentration on percentage inhibition (PI) for the four polyethoxylated naphthenic acids with ethylene oxide moles of 5, 10, 15, 20 respectively. It can be seen that the (PI) increases rapidly with increasing concentration up to 30 ppm. further increase to 40 ppm. brings about small increase. At concentration of 50 ppm. or

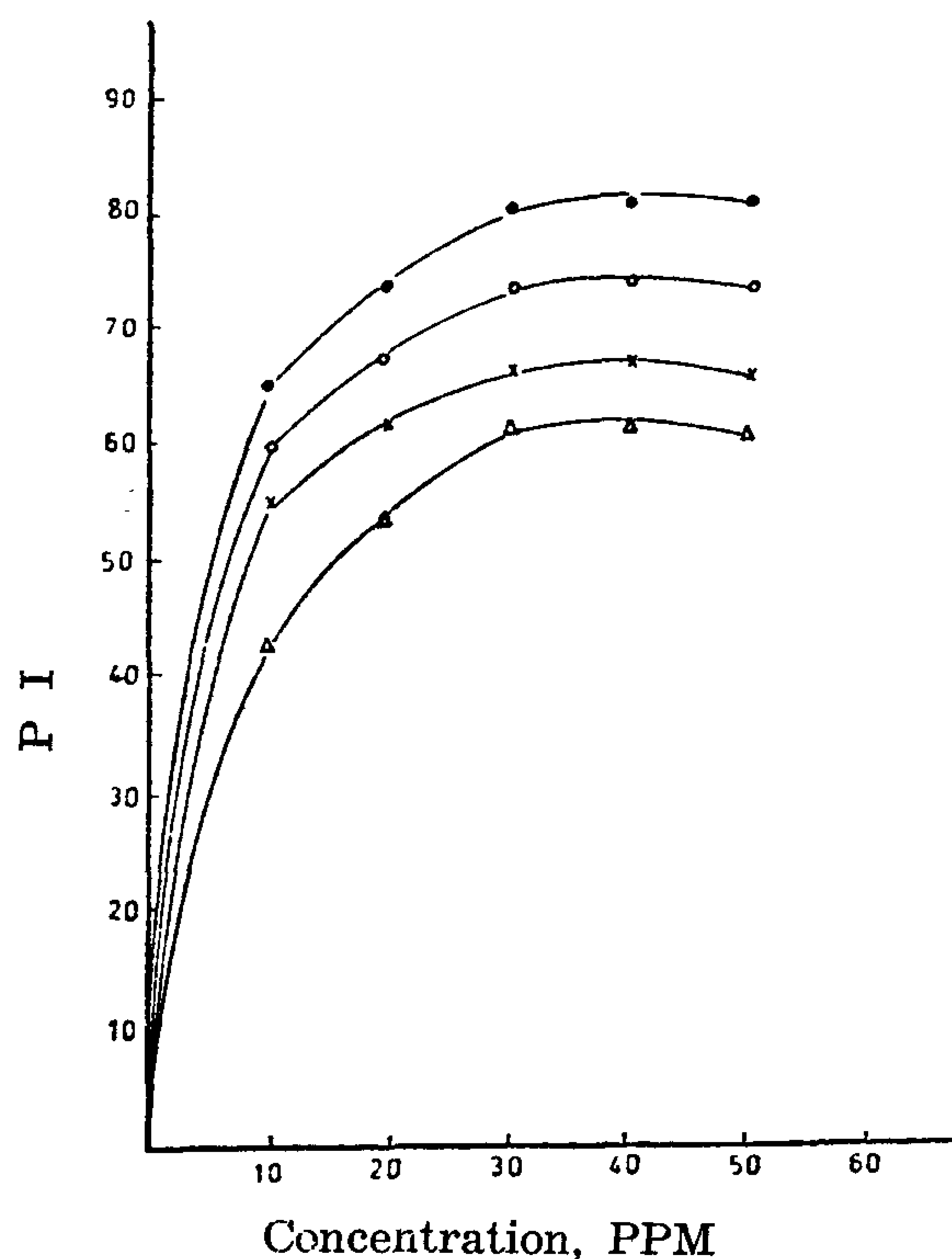


Fig. 2 Effect of Concentration of Polyethoxylated Napythenic Alcohol on Percentage Inhibition.

higher more or less constant values of PI are approached. The results may be explained on the basis of the relation between the functional group and structure of the inhibitor, since inhibitors can bond to the metal surface throug the functional group of electron transfer to the metal forming a co-ordinate type of link. The structure of the rest of the molecule can affect co-ordinate bond formation by its influence on the electron density at the functional group (16-18). The results obtained indicate also that the inhibition efficiency increases as the oxyethylene content of the non-inonics increases. This may explained in the light of their molecular size i.e. the (PI) is dependent on the molecular size of the inhibitor. The increased molecular size of the adsorbed inhibitor molecules results in diminishing the surface area of the metal available for reaction with corresive materials. The effect of the critical micelle concentration CMC of the nonio-

Ethyle acetate (50 ml) was then added to decompose the unreacted $LiAlH_4$. The reaction mixture was coutiously poured into cold dilute sulphuric acid (250 ml) 10%) and the ethereal solution was separated and washed with water and then dried over anhydrous sodium sulphate. After removal of ether, the obtained alcohol was purified by distillation under reduced pressure, Table 1.

Table 1 : Specification of Naphthenic Acid, Methyl ester and alcohol.

Compound	B.n.°C 4mm	d_{20}	η_0^{20}	Acid No.	OH No.	Average M.W.(12)
Naphthenic acid	82-126	o.9163	1.4523	264	-	21o
Methyl naphthenate	62- 98	o.8243	1.4518	-	-	221
Naphthenyl alcohol	66-1o2	o.8825	1.45o6	-	282	198

Ethoxylation of naphthenic alcohol :

Nephthenic alcohol was ethoxylated in pressure of KOH according to a reported procedure (13) at 160°C. The extent of ethoxylation was followed by determining the ethylene oxide content at regular intervals of (1-6 h).

Corrosion inhibition test :

Carbon steel coupons measuring 50x 10x2 mm. were machine from carbon steel exchanger used in Egyptian refineries. The coupons had the following chemical composition : C : 0.06.0.18, Mn 0.27-0.63, P_{max} 0.048 S_{max} 0.058% and the balance being iron. Before each experiment, new coupons, were polished using grade number 220,320 and 400 reased with acetone ,dried and weighted. water proof silicon carbide paper deg- Three weight coupons were suspended in a round bottomed flask solution at 70°C. A definite volume of the solution to be evaluated was then poured into the acid (0.05 N HCl) solution to give the required concentration (10-50 ppm.) After 1.5 hour. the coupons were removed. flushed under running water, immersed is a pickling solution (1g. thiourea in 1 L 10% H_2SO) for 10 minutes. flushed under water, dried and reweighed.

In control experiment no inhibitor was added and all other conditions was the same. The percentage inhibition (PI) was calculated using the following equation :

$$(PI) = \frac{W_o - W_i}{W_o} \times 100$$

Where W_o and W_i are the rates of corrosion (mg $cm^{-2}h^{-1}$) without and in the presence of inhibitor respectively.

Critical micelle concentration CMC

Following Larienov (14) method, the critical micelle concentration of the prepared nonionic had obtained graphically from curve relating surface tension as a function of concentration at constant temperature. The concentration at which inflection observed in these graphs was e quivelant to theCMC values of the nonionics under investigation.

RESULTS AND DISCUSSION

Under the experimental conditions for esterifying of naphthenic alcohol with methanol more than 90 percent of the theoretical yield of the ester is obtained The methyl ester is oily liquid generally of a light yellow colour having a saponification number of 245. Reduction of the resulting ester using $LiAlH_4$ gives naphthenic alcohol with about 40 percent

CORROSION INHABITORS FROM PETROLEUM NAPHTHENIC HYDROCARBONS POLYETHOXYLATED NAPHTHENIC ALCOHOLS

S.A. Fam.*, N.S. Ali*, M.A. Youssif* and A.M. Motawie*

ABSTRACT

Synthesized Naphthenic alcohols are ethoxylated to polyethoxylates covering a range of 5-20 ethoxy groups per molecule. Corrosion studies of the non-ionics revealed that a maximum inhibition efficiency of about 80% are obtained for some compounds. It has been found that the corresosion inhibition efficiency increases with the increase of the ethylene oxide content and with the increase of concentration up to 50 ppm. Comparative tests indicate that polyethoxlated naphthenic alcohols are generally more efficient as corrosion inhibitor than the corresponding ethoxylated naphthenic acids.

INTRODUCTION

The use of high molecular weight organic inhibitors (1-9) for reducing corresion in crude units (10) has increased to an extent which makes them an essential industrial product. Most of these compound are long chain fatty amines. imidazolines and their derivatives, derivatives of urea and thiourea, sulphides, aldehydes, and quaternaries. The action of this type of compounds is commonly attributed to their adsorption on the surface of the metal, where they reduce the number of active sites for the electrochemical reactions and possibily interfere with energetic of the corrosion reaction.

The present work synthesized naphthenic acids were converted to naphthenic alcohols which were then ethoxylated ot nonionic with various number of ethylene oxide moles. The evaluation of these non ionics as corroson inhibitors is the object of the present study.

EXPERIMENTAL

Preparation of Naphthenic Acids :

Petroleum fraction rich in naphthenes (b.p. 160-210°C) was oxidized in the liquid phase with air in the presence of mixed catalyst (manganese and calcium naphthenates) according to the procedure described in (11). The obtained naphthenic acid is specified in Table 1.

- Esterification of Naphthenic Acid :

A mixture of naphthenic acid (0.3 mol) methanol (300 ml) and concentrated sulphuric acid (5 ml) was heated at reflux for sik hours. The mixture was washed three times with cold dilute sodium caarbonate solution and twice with wataer and was then dried over anhydrous sodium sulphate. The obtained ester was purified by distillation under reduced pressure (Table 1).

Preparation of naphthenic alcohol :

A solution of the methyl ester (0.3 mol) in anhydrous (200 ml) was added dropwise to a suspension of L_iALH_4 (0.5mol) in dry ether (300 ml) with vigorous stirring under anhydrous condition at room temperature. After complete addition stirring was continued for further 10 minutes.

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V-RECOMMENDATIONS

It is recommended to:

1 — Carry out more experimental work to obtain a general reliable strength and energy indices represent all Egyptian building bricks.

2 — Search for a general index which comprise the most physical and mechanical properties of the building bricks (not only strength and energy characteristics).

3 — Introduce the cost of the production of different brick types as a factor affecting the choice of the brick type for a certain job.

4 — Find out a general mathematical model which determine the brick suitability according to the different engineering characteristics, energy characteristics and costs.

5 — Study in details the energy consumption rates during the interprocessing stages of different brickmaking technologies and how to audit the consumption of this energy especially for desert shale and gas concrete bricks, which is the subject of the coming investigation.

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8. Verfahren und Betri «Handbouh fur die ziegelindustrie» Ziegelindustrie, ebspraxis in dir Grobkeramik.

ween the raw materials, manufacture technique and production capacity.

Table (6) and figure (7) generally summerizes the results of the existing work.

Brick Type	Strength Index	Energy Saving Index
Red	1.00	1.00
Concrete	1.43	1.62
Sand Lime	10.71	1.29
Gas Concrete	2.71	0.65
Desert Shale	4.64	0.51

Table (6) Brick strength and energy saving indices.

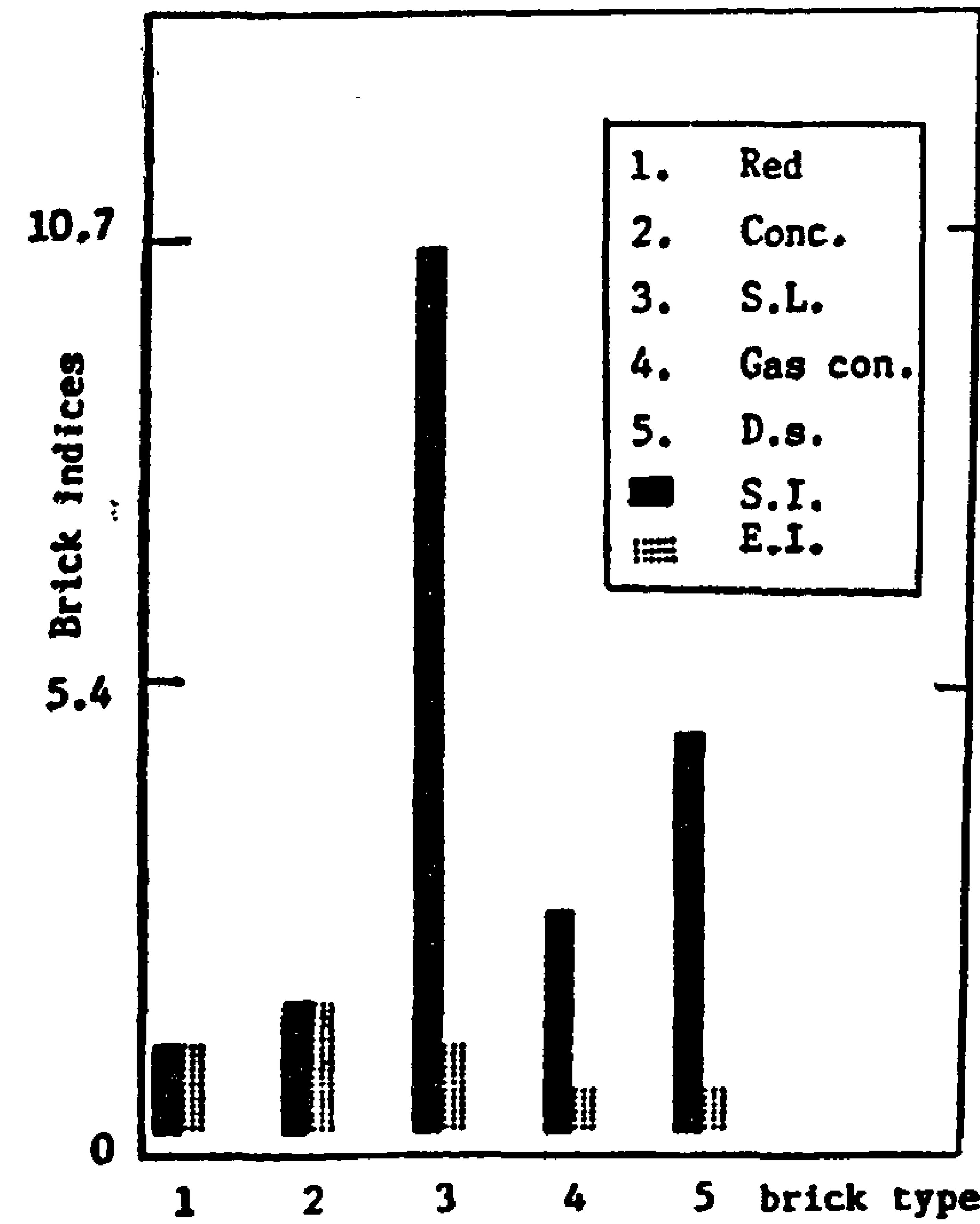


Figure (7) Brick strength and energy ... saving indices.

IV-CONCLUSION

The following chart (figure 8) generally concluded the results of the present work that can be summerizes in the following points:

1 — From the energy saving point of view (y-scale), concrete building blocks represent the optimum substitute followed by sand lime bricks, gas concrete blocks and desert shale bricks respectively.

2 — from the strength point of view (x-scale), sand lime bricks represlnt the optimum substitute followed by desert shale bricks, gas concrete blocks and concrete building blocks respectively.

3 — The nature of the construction job and the function of the building bricks decide the choice of the brick type. For jobs which needs wall bearing bricks (right side) the choice must be between the sand lime and desert shale bricks, hence the type which offer the maximum energy saving index (sand lime bricks) must be choosed. When bricks are used as partitions (left side) which needs ordinary compressive strength, the concrete building bricks must choose because it offer the minimum energy consumption rates (maximum energy saving index).

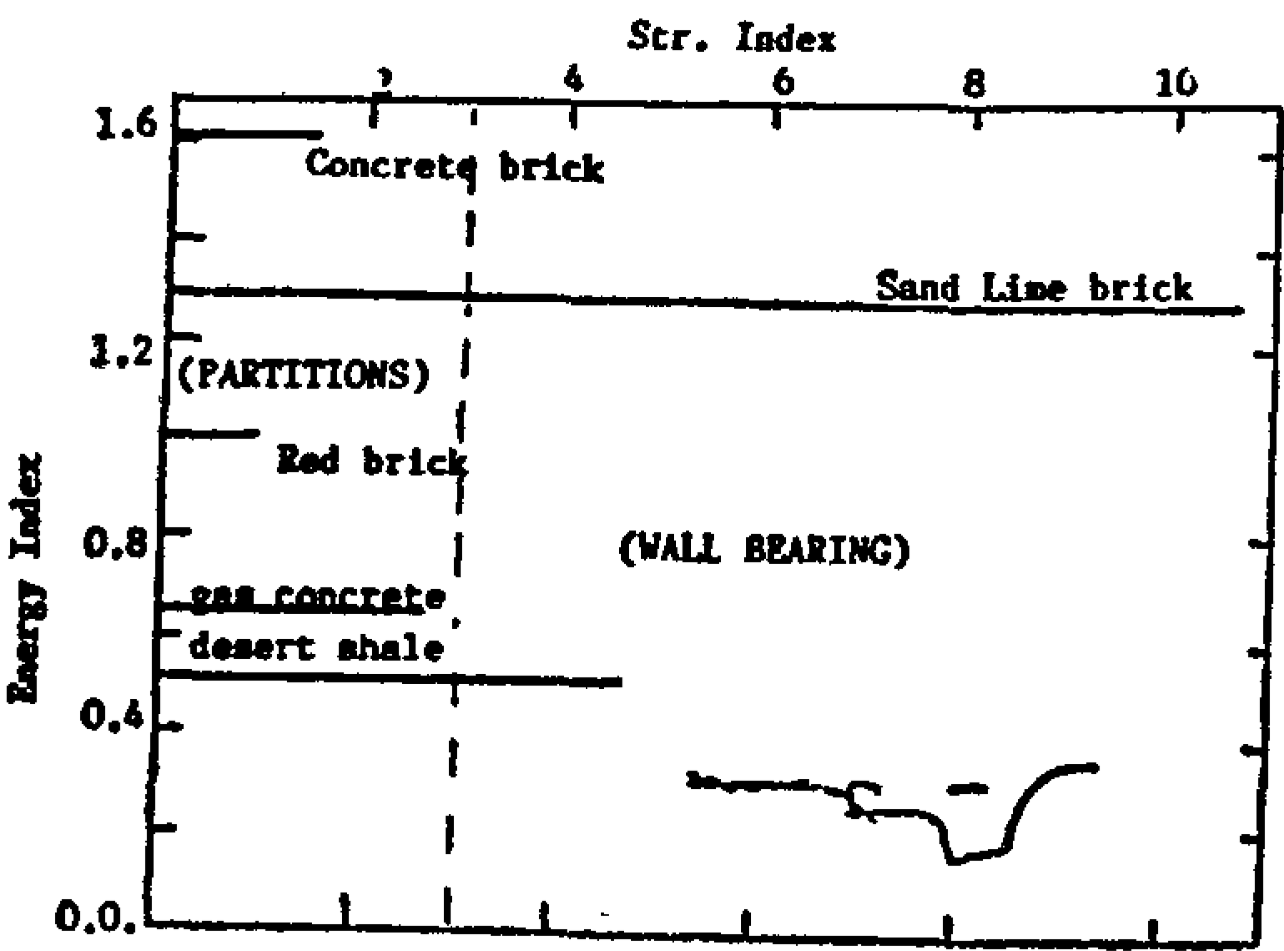


Figure (8) Limits of brick utilization according to their strength and energy indices.

Brick Type	Energy Consumption/Ton		Energy Consumption (k.oal./ton) ($x10^4$)	Mean Value k.cal/ton ($x10^4$)
	Fuel Energy kg	Electricity kwh		
Concrete				22.30
1. Assal Co.	0	984.66	22,2872.61	
2. El Nasr Co.	0	985.59	22,3083.11	
Sand Lime				24.85
1. Quesna Co.	27.45	3.75-5	27,8264	
2. Nasr Co.	21.49	3.75-5	21,8663	
Gas Concrete				55.08
1. Quesna Co.	57.42	30.9	60,0777	
2. Nasr Co.	47.42	30.0	50,0777	
Desert Shale				70.94
1. Misr-Ira Co.	50,80	39.58	54,2043	
2. Sigwart Co.	'65.48	59.45	70,5935	
3. Misr Co.	79.13	103.27	88,0122	

Table (4) Energy consumption rates for the production of different brick types (present work).

Brick Type	Energy Consumption (k.cal x 10^4)	Energy Saving Index (E.I.)
Concrete	22.30	1.62
Sand Lime	24.85	1.29
Red	36.00	1.00
Gas Concrete	55.08	0.65
Desert Shale	70.94	0.51

Table (5) Energy saving indices for different brick types

III. DISCUSSION OF RESULTS

The critical analysis of the previous results revealed that :

1. Sand lime and desert shale bricks characterized by their high strength indices (4.64 and 10.717) respectively while concrete and gas concrete blocks has an average values of (1.4 and 2.7) times the red brick strength (Figure 3).

2. Most investigators (1-3) accepted the value of $36x10^4$ k. cal as the energy needed for processing of one ton of red brick (1,5,7) estimate this value as $(22.2\text{-}24.5)$ $x10^4$ k. cal for concrete blocks which confirmed with the results of the present work ($22.3x10^4$ K. cal/ton).

3. The present work confirmed with the work of (3) in his estimation of the energy required for processing of one ton of concrete blocks.(3) suggest the value of $59.15x10^4$ K. cal/ton while the present work determined it as $55.1x10^4$ K. cal/ton (Tables 3 and 4).

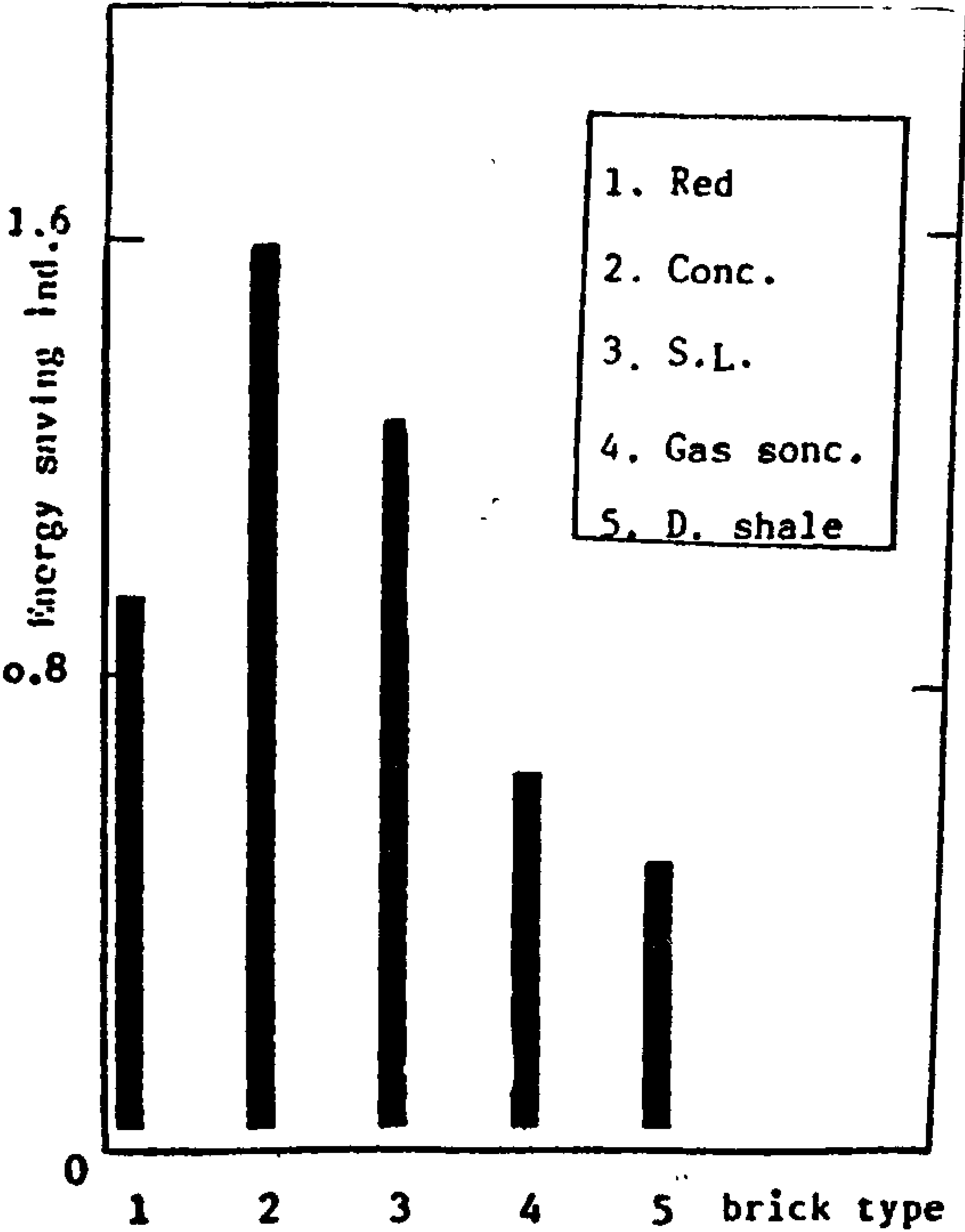
4. There are great difference between the different investigators (1,2,4,5,7,8) in their estimation of the quantity of energy needed for processing of the desert shale brick. The previous estimated values ranged between (32 to 67)$x10^4$ K. cal/ton while the present work estimation range is between (54 to 88) $x10^4$ K. cal/ton with an average value of 71x10 . The great variation between the estimated values can attributed to the difference bet-

Brick Type	Energy Consumption/(Ton of Produced Bricks)						
	Ramez (1)	Elarousi (2)	Asik (3)	Hassan (4)	Gohbpr (5)	Goi (7)	Verfahren (8)
Red							
Mazout (kg)	37.30	37.30	37.3	-	19.09 (6)	-	-
Elect (Kwh)	0	0	0	-	0	-	-
K. Calexe 4	36.00	36.00	36.0	-	19.09	-	-
Concrete							
Mazout (kg)	23.70	28.70	-	-	23.70		-
Elect (Kwh)	5.90	-	-	-	7-10	258.6	-
K. Calexe 4	24.33	29.21	-	-	24.3-24.6	22.2	-
Sand Lime							
Mazout (kg)	31.75	34.50	34.5	-	15	-	-
Elect (Kwh)	4.38	-	-	-	17-18	-	-
K. Calexe 4	32.13	34.50	34.5	-	16.55	-	-
Gas Concrete							
Mazout (kg)	-	34.50	57.0	-	-	-	-
Elect (Kwh)	-	-	25.0	-	-	-	-
K. Calexe 4	-	34.50	59.15	-	-	-	-
Desert Shale							
Mazout (kg)	32.57	32-57	-	33.5	40-62	33.5	40.50
Elect (Kwh)	10.6-25	0	-	29.5	19-62	14.7	25-62
K. Calexe 4	33-59	32-57	-	36.0	41.7-67.3	35.4	42-55

Table (3) Energy consumption rates for the production of different brick types (previous work).

3. BRICK ENERGY INDEX (E.I)

By taking the energy consumption rate in red brickmaking as a base for comparison. It can develop an energy saving index (E.I.) for different substitutes. This index is the inverse ratio of the energy consumed in different brick production to that consumed in red brickmaking. The greater the index value the better is the energy saving of the brick. Table (5) arranged the different brick types according to their energy saving indices Figure (6) show the energy indices of different substitutes.



Figure(6) Energy saving indices for different brick types

its value. By taking the red brick compressive strength as a base for comparison. It can construct an strength index (s.i) for the different brick types. This index is the ratio of the brick compressive strength (the minimum value) to the red brick compressive strength. The greater the strength index the strenuous the brick. Table (2) and figure (3) show the estimated strength indices for the different brick types. It must be noticed that all substitutes has a compressive strength and strength indices greater than that of the red brick, which is accepted before as a building material, i.e., all substitutes satisfy the strength requirements.

Brick Type	Minimum Compressive Strength (kg/cm²)	Strength Index (S.I.)
Red (estimation base)	14	1.00
Concrete	20	1.43
Gas Concrete	38	2.71
Desert Shale	65	4.64
Sand Lime	150	10.71

Table (2) Strength indices for different brick types

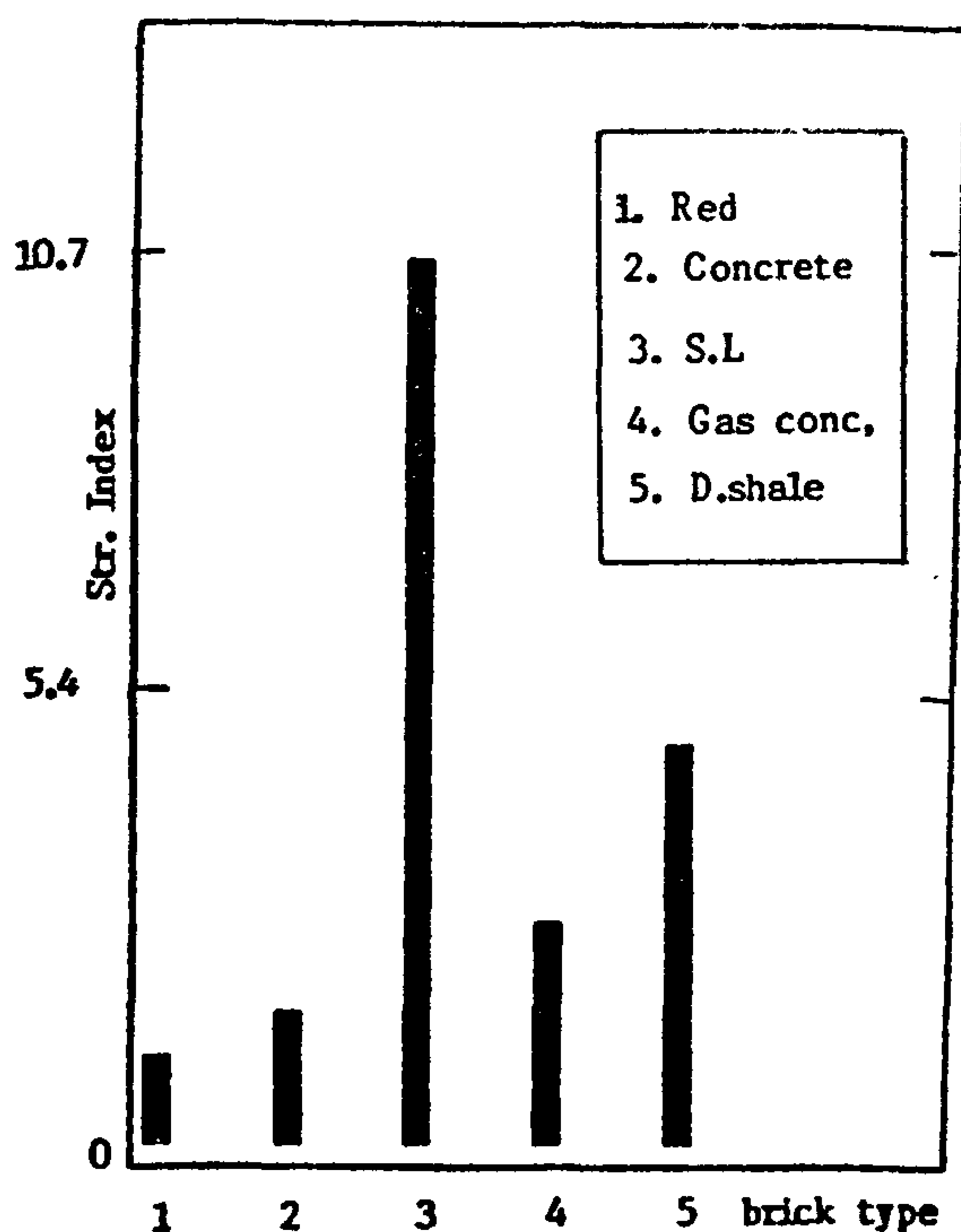


Figure (3) Strength indices for different brick types

B. ENERGY CHARACTERISTICS

1. PREVIOUS WORK

Table (3) and figure (4) summerizes the energy consumption rates during the processing of different brick types as outlined by various investigators (1-8) in Egypt and some developing countries.

2. PRESENT WORK

Table (4) and figure (5) summerizes the results of the present field work.

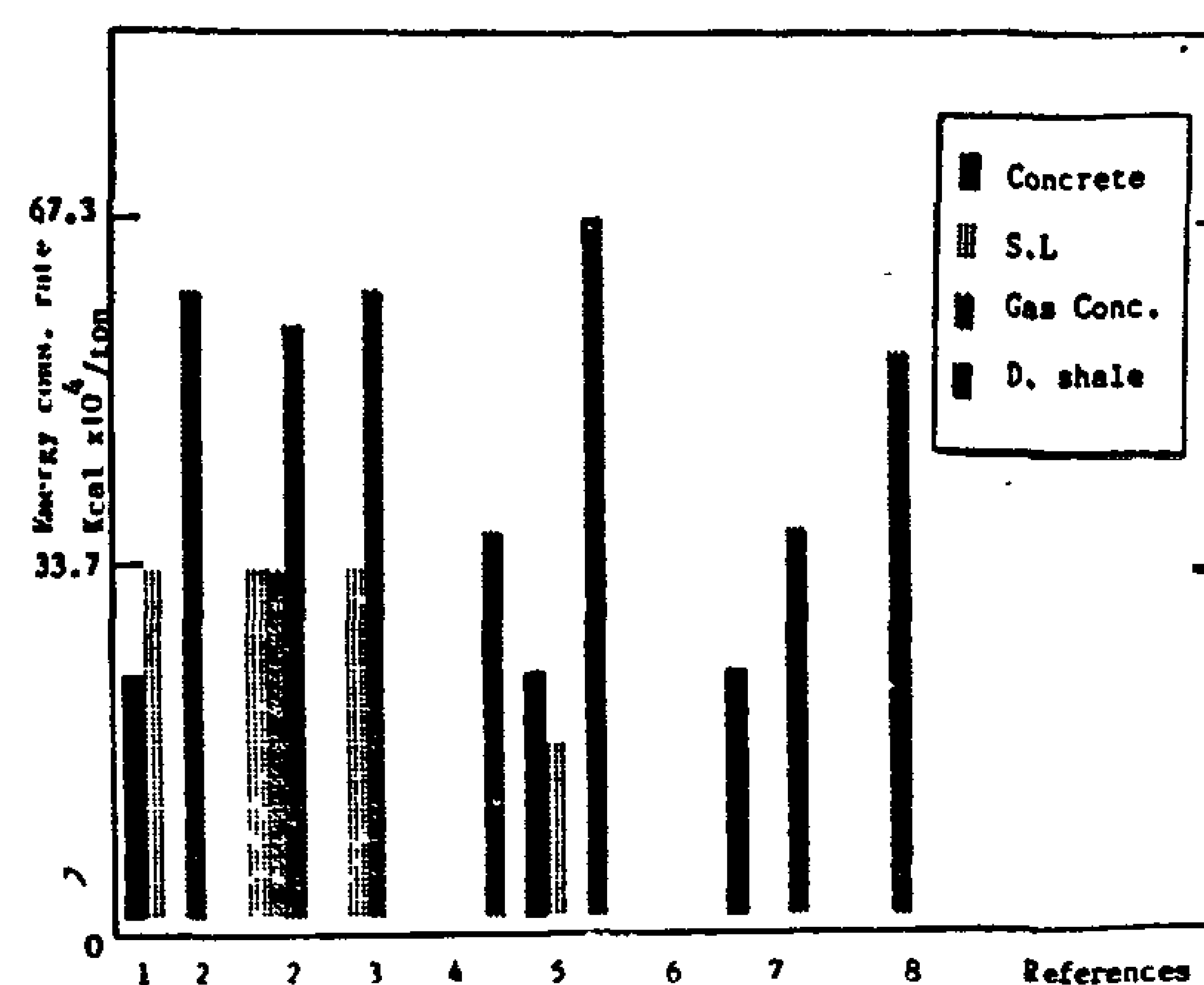


Figure (4) Energy consumption rates for the production of different brick types (previous work)

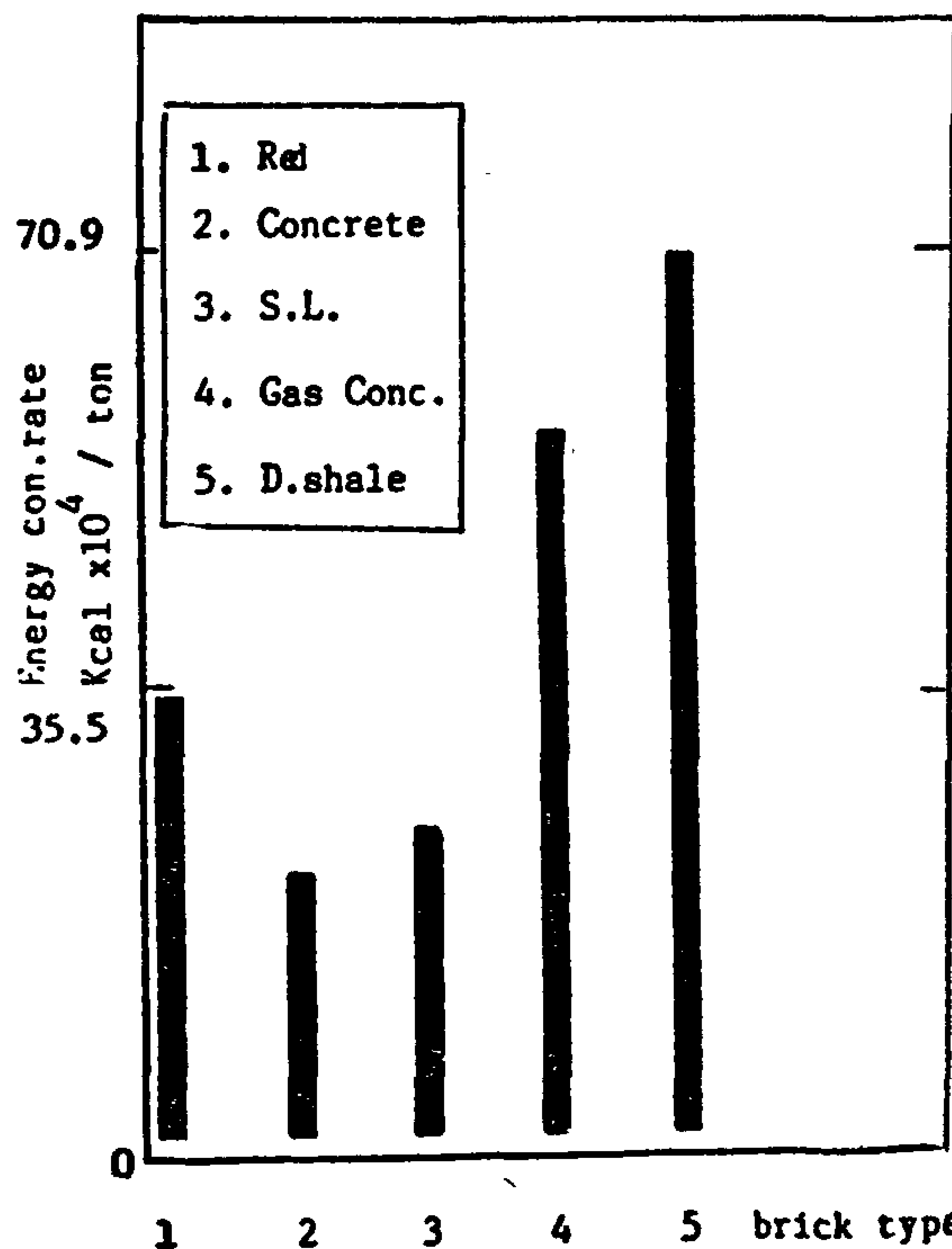


Figure (5) Energy consumption rates for the production of different brick types (present work)



Figure (1) Exploitation of the upper agricultural fertile layers for red brick-making

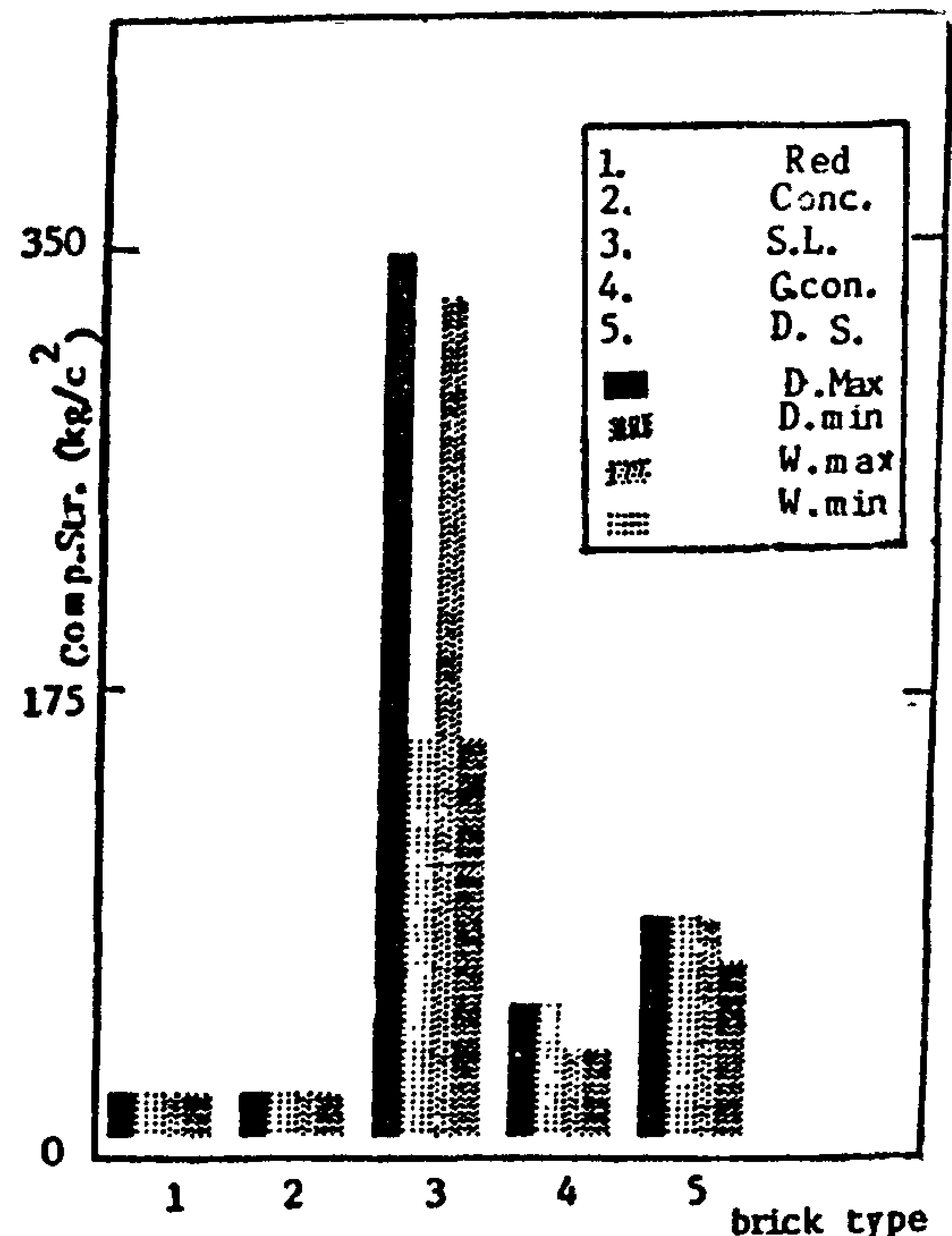


Figure (2) Compressive strength of different brick types (after 1 and 2)

II. RESULTS OF THE FIELD WORK

A. ENGINEERING CHARACTERISTICS

Table (1) summerizes the main physical and mechanical properties of the previous substitutes as outlined by Ramez(1) and Elarousi(2). The comparison between the different brick strengths is shown in figure(2).

1. BRICK STRENGTH INEX (S.I)

Compressive strength is the main engineering parameter which characterize any brick type. The brick efficiency and suitability for certain job depend mainly on

Table (1) The main engineering charac- teristics of the different building bricks (after 1 and2).

Physical and Mechanical Properties	Brick Type				
	Red (1)	Concrete (2)	Sand Lime (3)	Gas Conc. (4)	D. Shale (5)
Dimensions (cm)	25x12x6 -	25x12x6 +	25x12x6 -	50x25x12 +	25x12x6 +
Weight (kg)	2.8	3.6-4	3.2	12	2.54
Thermal Isol.	good	poor	poor	v. good	good
Vol. Wt. (1/m³)	1.5-1.7	1.15	1.84	.82	1.3-1.4
Water Abs. (%)	14	8-15	12	31	7
Dry. C.S. (kg/cm²)	18	20	160-350	48	68-90
Wet. C.S.	14	20	150-340	38	65-86

+ there are other sizes. - One size only.

TRAIL TO DESELOP ENERGY AND STRENGTH INDICES FOR SOME EGYPTIAN BUILDING BRICKS

Dr. SAID ABDEL MEGID EL-ADAWY

ABSTRACT

A trail to develop some indices to arrange the Egyptian building bricks according to their compressive strength as well as to their energy consumption rates is made. A rational values for different red brick substitutes are suggested. These indices has a valuable benefits in the planning for the brick industry to decide the most suitable brick types and technoligies that meet the strength requirements as well as the energy conservation plans.

1. INTRODUCTION

The majority of the building bricks which manufactured in EGYPT, until 1985 was the traditionally known "red brick". It used mainly the "Nile silt" as a basic raw material. Brick processing is usually carried out in small plants known as "Kamina" where mazout is used for firing.

After the construction of the high dam, the Nile silt is prevented entirely. The need for the building bricks is critically creased to solve the acute housing problems. The top agricultural fertile soil layers began to excavate from the cultivated lands (figure 1) to use in the red brickmaking. This destruction of the agricultural wealth forced the government to stop the red brick production, starting from August 1985, and to search seriously for other substitutes. Several brickmaking technologies began to invade the local market to satisfy its thirst to bricks. Under the existing energy shortage, the most recommended substitute is that one which meet, not only the engineering requirements, but also the energy conservation plans.

1. THE OBJECTIVES

The present work is a rational trail to develop some energy and strength indices for the different red brick substitutes. These indices are a measures of the brick compressive strength as well as of the energy consumption during their processing. The development of such indices has a valuable benefits to the planner, on the national level, to put forward a master plan for the brick industry that will meet the requirements of the energy conservation plans. It also help the decision maker to decide the most suitable brick type and technology which satisfy both the strength and energy requirements for short and long term investments plans.

In the present work, the following four main red brick substitutes are cirtically studied :

1. Concrete blocks
2. Sand lime bricks
3. Gas concrete bricks
4. Desert shale bricks

CONCLUSIONS

Razzak oil field is a faulted anitclinal dome-like structural oil trap. Beginning of the formation of this structure dates back to Coniacian (the early stage). Then the structure attained its present day shape at the end of Maastrichtian (the late stage). The principle zone of oil formation was determined in this area at depth 3650m and subsurface temperature degree 95°C.

It is concluded that oil generation in Jurassic source rocks in the area was started before the end of Miocene time after the formation of oil trap. Cretaceous source rocks in Neocomian, Aptian and Cenomanian sections not reached the principal zone of oil formation. Paleozoic sediments seem to be located within the zone at the beginning of Cretaceous period before the trap formation, but generation of oil in these sediments probably was continued after the trap formation. ...

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Then they have been completely settled in the zone since the beginning of Paleocene time. This means that, oil generation in Paleozoic source rocks - if present - was started before the formation of oil traps in the area.

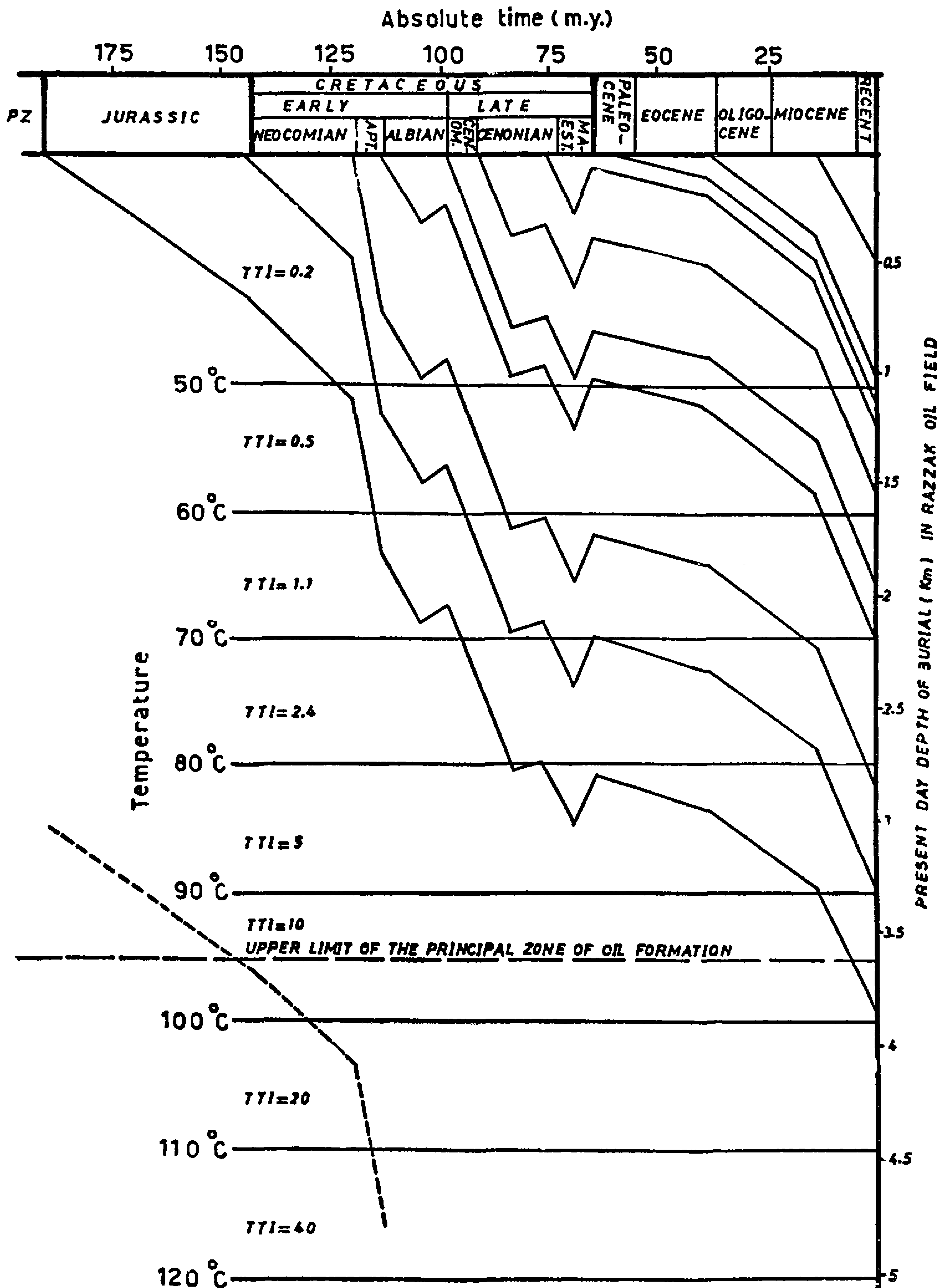


Fig. 6 Burial History diagram of Razzak area, western desert, Egypt.

generation at R_o range from 0.65 to 1.3.

Preliminary study of geochemical characteristics of some shale and carbonate core samples obtained from Razzak wells indicates that Neocomian, Aptian and Cenomanian sediments have a considerable organic carbon content (TOC 1%), organic matter content (OM = 1.5%, and bitumen content (EOM, from (0.05 to 0.15% Moreover, these sediments mainly consist of sandstone and shale intervals with presence of a thick dolomite bed Alamein Dolomite) in the upper part of Aptian section. According to Parker, 1982, Middle Jurassic sediments and Cenomainian clastics contain oil prone Type II source rock in Razzak area, while within Neocomian-Aptian sedimentary section in the area of Meleiha-Alamein mixed Type II/III source rock is present. Furthermore, these deposits are considered to be a good source rock by the previous studies of O'Conner, 1975, and Showmelava, 1977.

Consequently, the sediments of Jutassic, Neocomian-Aptian and Conomanian horizons have all the evidences of being a good source rock in case of the availability of the favourable geological and physical conditions required for hydrocarbon generation. Therefore, these sedimentary horizons are considered to be probable source rocks and their burial histories are carefully studied in this work.

For the calculation of TTI values of the probable source rocks, 10°C intervals of increasing temperature with depth are plotted on the burial history diagram (Fig. 6). Then, based upon the calculated range value of TTI and the equivalent range value of R_o, the upper boundary of the principal zone of oil formation was layed out on the diagram. This indicated that, this upper boundary of the principal zone of oil formation lies at depth 3650m and subsurface temperature equals to 95°C. At this boundary, TTI value reaches about 15 increasing downward to 40 at depth 5000m and temperature 120°C The burial history of each probable source rock is pursued, in order to, declare whether it entered the principal zone or not, and to determine the time of enterance.

Follow of the Jurassic source rocks indicates that, these sediments seem to be entered the principal zone of oil before the end of Miocene period. Since that time Jurassic sediments have been located within the zone (thickness of Jurassic rocks is about 600m in Razzak area as estimated from the regional isopach maps of the Western Desert). Neocomian clastics, Aptian carbonates and clastics, and Cenomanian clastics so far not reached the principal zone of oil formation in the studied area (Fig. 6). Consequently, it is concluded that oil generation process in the area was started within source rocks of Jurassic age at the end of Miocene and continued up till now. Also, it is concluded previously that, the early stage of Razzak structural trap formation was started during Coniacian, while the main stage at the end of Maastrichtian when the trap attained its present day structure. The relationship between timing of oil generation and structural development reveals, that oil generation was started in the area after the completion of the trap structure. This gave rise to accumulation of the generated by drocarbons into the trap since the end of Miocene time only. This may give an explaination to the small amount of trapped oil in Razzak field reservoir rocks.

On the other hand the pre-Jurassic sediments (Paleozoic rocks) which have a thickness equals to 2900m in Razzak area (according to the data in the Document of E.G.P.C., in 1974) seem to be entered the principal zone of oil formation at the beginning of Cretaceous period.

TABLE 1. EROSION INTERVALS IN RAZZAK AREA :

Rock stratig-raphic unit	Age	Thickness deposited, m.	Thickness at present m.	Thickness eroded, m.
Moghra+Marmarica FMs	Oligo -E Miocene	1002	676	326
Khoman FM.	Santon -Maastrich	299	68	231
Abu Roach FM.	Turon -Coniacian	393	337	56
Kharita	Albian	302	225	77
Total		1996	1306	690

For estimation of maturity levels through the time, a geothermal gradient was constructed for the area, (Fig. 5).

Temperature data from DST's and well log BHT data were plotted and a best fit curve was used o calculate a gradient of 1°C per 59m (17°C/1km). It is assumed that, the present day gradient is the same as the paleo-geothermal gradient. This is due to the gentle and mild tectonic movements which affected the area throughout its geologic history. Therefore, the probability of significance rising or lowering in temperature is excluded from this area.

There have been a number of attempts at quantitative expression of the time-temperature relation in petroleum formation. By far the most influential of these attempts was that made by Russian scientist N.V. Lopatin, who in 1971 calculated the thermal maturity of organic matter in sediments by a time-temperature index (TTI). In this work, based on the geothermal gradient and burial history diagram of the sediments in the area, TTI values according to Lopatin's method are calculated, TTI= $\sum 2^n \Delta t$.

The present day geothermal gradient of Razzak area

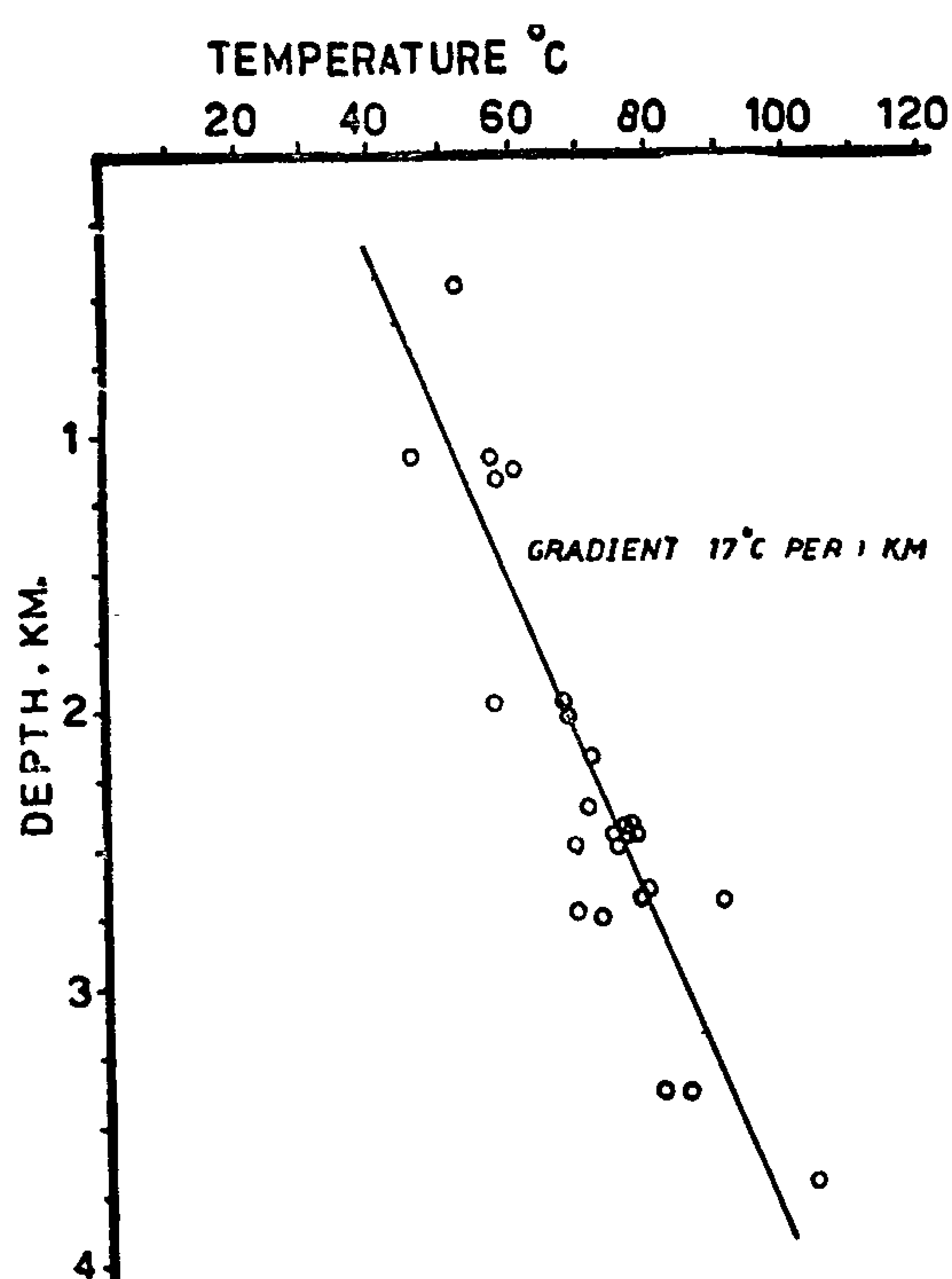


Fig. 5

Empirically, vitrinity reflectance (R_o) which expresses the thermal maturity degree of sediments, can be correlated to the time-temperature index (TTI). Hence, TTI values can be directly trnsformed and read as values of R_o. According to Waples, 1980, TTI value ranges from 15 to 165 is equal to the threshold of oil

the end of Maastrichtian, Razzak area became rather gently folded and stood relatively high (Fig. 4). The effect of these compressional forces on the sedimentary section of the Western Desert was denoted before by Said, 1962, Norton, 1971 and Meshref, 1973, 1982, in addition to many other investigators after them.

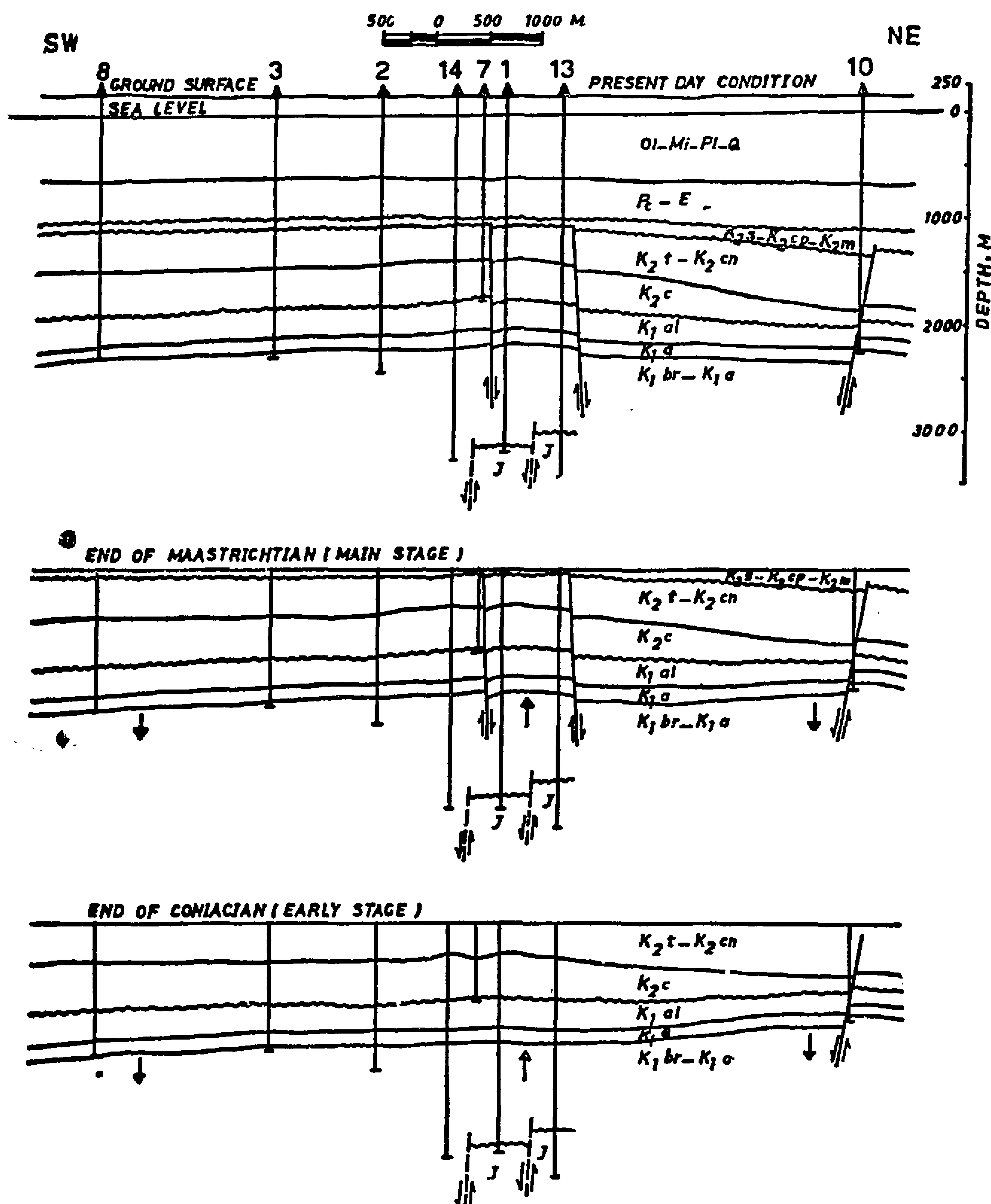


Fig. 4. Paleotectonical profiles in Razzak oil field area, western desert, Egypt. The present day geothermal gradient of Razzak area.

BURIAL HISTORY AND THERMAL MATURATION

Burial history curve is constructed for Razzak sediments using both geological and electrical well log data of all drilled wells in area. Table 1 shows the estimation of the deposited thickness, preserved thickness, and eroded thickness of each lithostratigraphic horizon subjected to erosion.

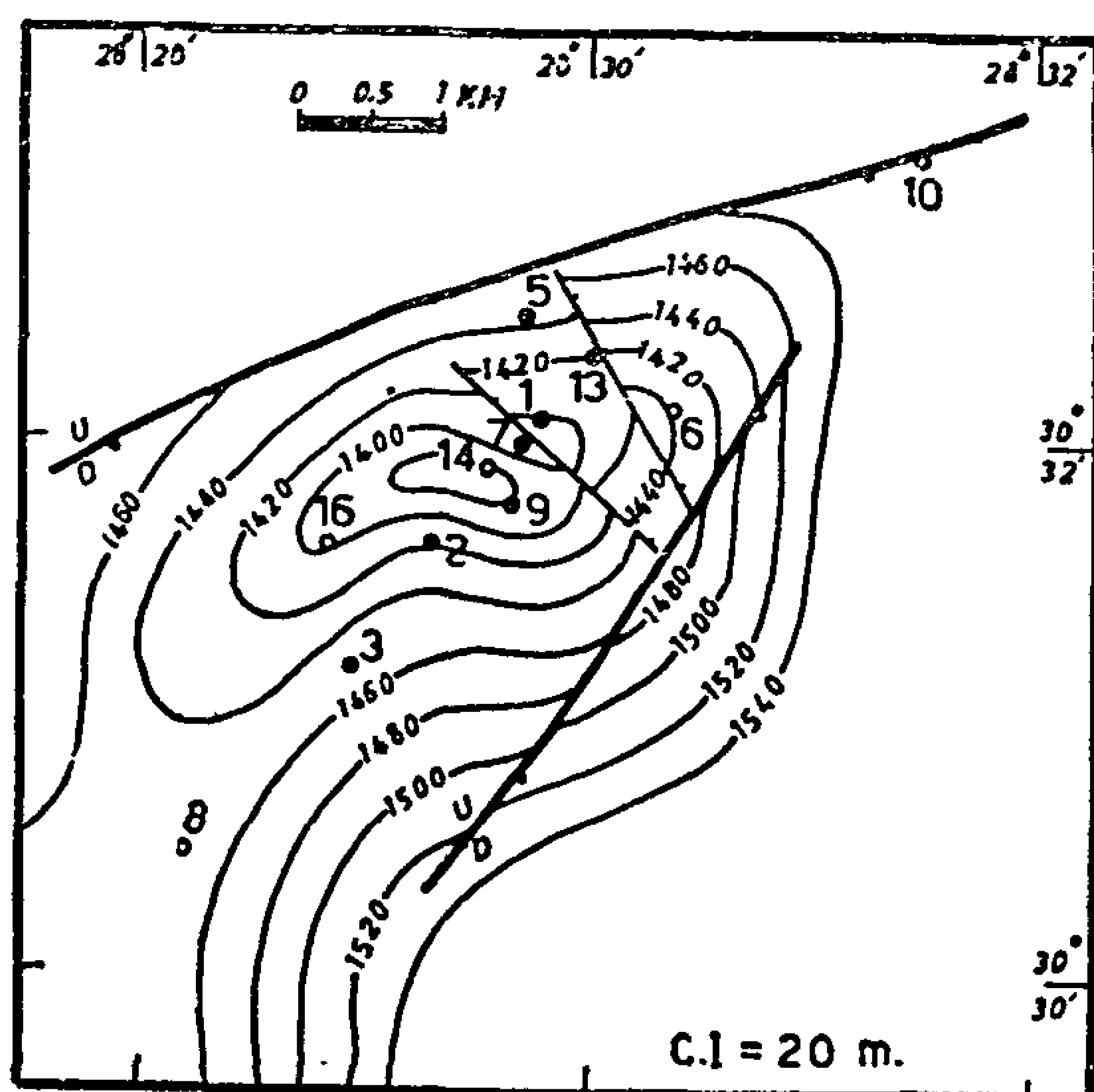


Fig. 3. Structure contour map of Cenomanian sediments

14. Well Number, o-Dry Hole, ● Oil Pro-Productive Well.

Consequently, Razzak oil field could be classified as a structural oil trap (faulted dome-like) formed by both folding and faulting processes. This is nearly in accordance with the view of Ezzat and Dia Eldin in 1974 and others. Where they denoted that, Razzak field is a strocturally controlled oil trap, which lies on the northeast plunging anticlinal nose of one of a series of structural highs forming the Alamein-Qattara Rim Aptian ridge.

GEOLOGIC HISTORY AND PALEOTECTONICS

Due to the shortage of data obtained from drilling about pre-Cretaceous sediments in Razzak area, interpretation of geologic history and paleotectonics of these sediments in the area is carried out depending upon the regional information denoted in previous studies. According to Khaled, 1974, during Jurassic period subsidence accompanied with marine transgression cycles took place allover the Northern Western Desert. This gave rise to the deposition of thick marine sediments in this area. At the end of Jurassic, most of the Western Desert was uplifted with block faulting process as a result of the Late Kimmerian tectonic movement (the second phase of Alpine orogenv). Consequently, Jurassic sediments were exposed and differentially eroded ledding to the and differentially eroded ledding to the formation of the well defined unconformity surface on the top of Jurassic rocks in the area..

Razzak area, which is located near the central part of the Northern Western Desert, has all the evidences of being a place affected by subsidence during Jurassic period. Also, the unconformity surface is recorded on top Jurassic sediments in scme wells-for example, Razzak well no.1-in the area.

In order to study the geologic history and paleotectonics of Cretaceous sediments in Razzak area, four paleotectonical profiles crossing the area along along different directions were constructed. In addition, structure and isopach contour maps were made for each top and horizon in the sedimentary section. Paleotectonical profiles indicated that, this area was affected by slow subsidence throughout Cretaceous period, except some hiatus which are recorded at Albian, Coniacian, and Maastrichtian times, when the area was uplifted and exposed to the erosional processes. This was indicated by the detection of unconformity surfaces on top of the sediments belonging to these time intervals .

The profiles also revealed that, formation of the present dome-like structure of Razzak field began at the Early Cenomanian time when the central part of the area was slightly uplifted and gently folded. This is considered as the early stage of formation of this structure. Then the area attained its present dome-like structure in the main stage of formation, which continued throught Santonian and Mastrichtian as a result of a NW-directed compressional forces (Late orogenic phase of the Early Alpine orogeny). By

diments that have been eroded and missed in the different intervals of the uplifting and the exposure of rocks in the area. Among these wells : Qattara Rim-1 Kharita-1, Tarfa-1, Yidma-1, Alamein-1, Dahab-1, and Daba-1,

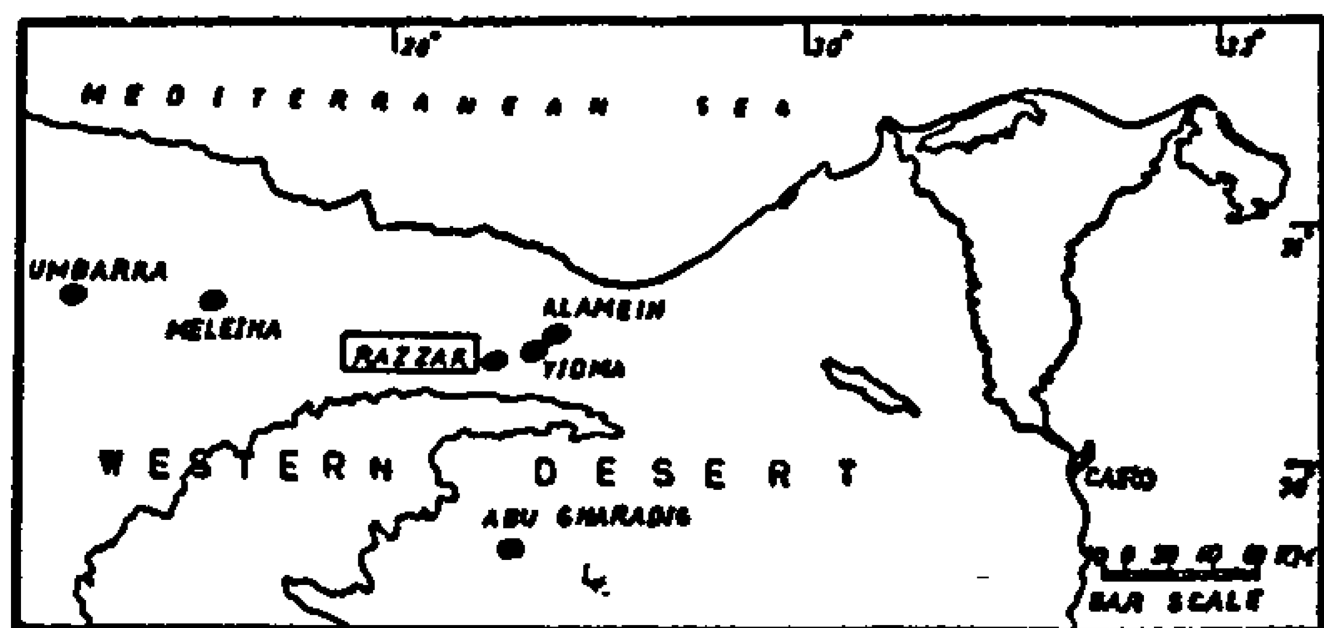


Fig.1 LOCATION MAP OF RAZZAK OIL FIELD IN EGYPT

Moreover, some shale and carbonate core samples from wells Razzak-1, 3, and 12, have been analysed for determination of their geochemical characteristics. Total organic carbon content% (TOC), organic matter% (OM), and total extractable dissolved organic matter % (EOM) were determned for preliminary evaluation of the probable source rocks in the area. TOC of each core sample is determined by combustion in "Sargent Combustion" apparatus in the laboratory of geochemistry, Faculty of Petroleum and Mining Engineering, Suez. Also, EOM was determined by successive bitumen extraction process using chloroform then ethyle alcohole-penzole mixture (1 : 2).

STRATIGRAPHY AND STRUCTURE OF RAZZAK AREA

Razzak area lies in the Northern Western Desert within the Unstable Shelf district. The stratigraphic sequence in the wells drilled in this area ranges in age from Jurassic to Miocene, with a maximum thickness of 3707m recodded in well no. 13.

Three dome-like structural features had been detected within the area on the Aptian and Cencmanian horizons by seismic surveys. The first one lies at the extreme southwestern part of Razzak area, while the second on the extreme northeastern part. In the central region, between the above mentioned two features, occures the third one, which is considered to be the main hydrocarbon structural trap and the most important one for oil producing in Razzak oil field. This trap has the form of a dome-like structure, which elongated in the NE-SW direction. Its long axis measures about 5 km, and the short one, at the widest part, reaches to 4km, measured on the Albian horizon (Fig. 2). This domal feature is dissected into neveral blocks by two sets of intersecting normal faults. One of these two sets is longitudinal and trending NE-SW. The transverse set is in the NW-SE direction. The NW-SE faults are numerous giving rise to step-like faulted blocks (Fig. 2, and 3). These faults although their displacement are not comparable with that of the other trend, yet it is compared with the traversed layers. The throw of the NE-SW trending faults is up to 100m. Most of these faults are verified and traced either by drilling and well control, or seismic surveying.

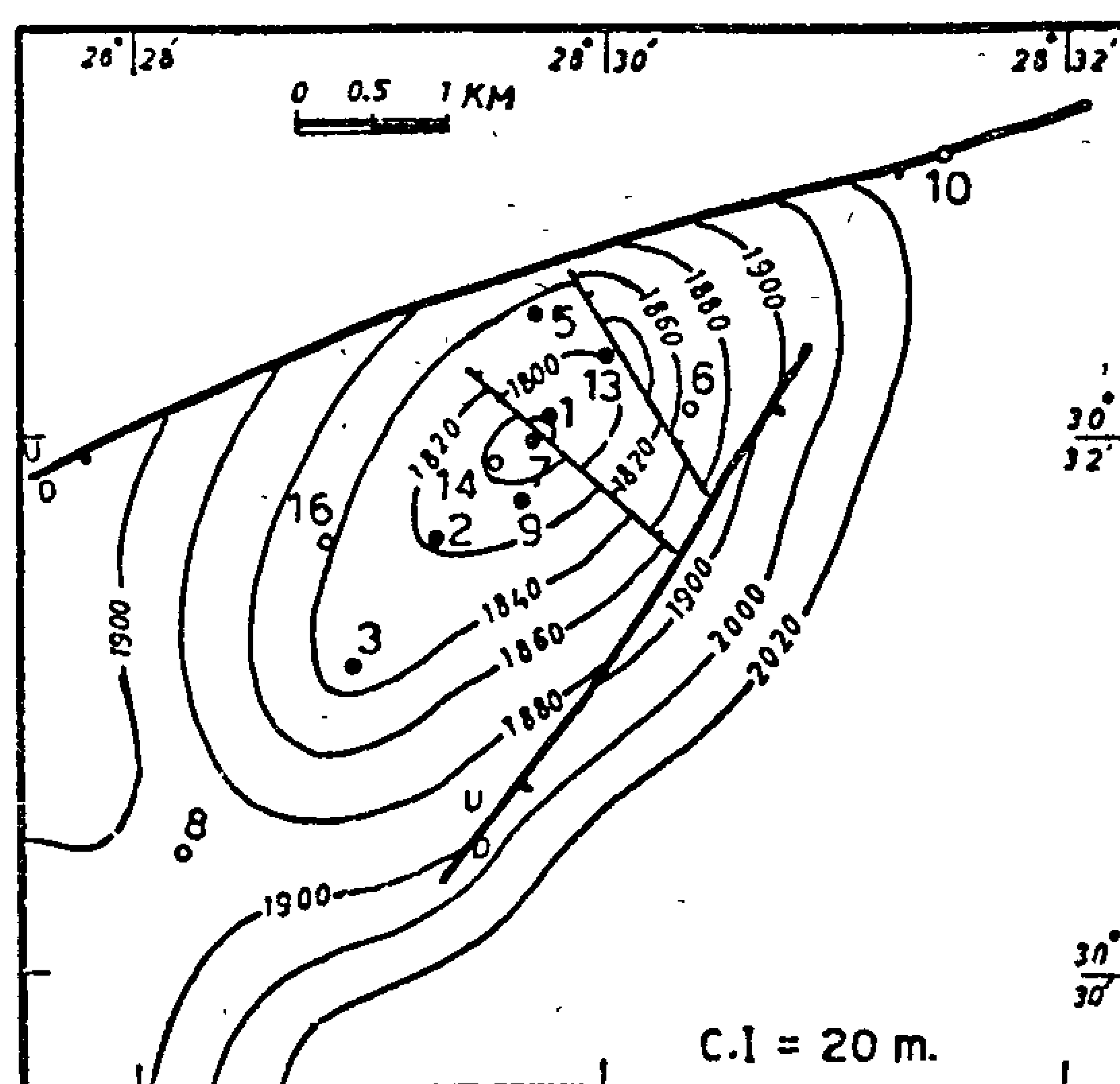


Fig. 2. Structure contour map of top Albian sediments

4. Well Number, o-Dray Hole, ● oil Productive Well,

ON THE TIME -TEMPERATURE RELATION AND MATURATION OF MESOZOIC SEDIMENTS IN RAZZAK AREA, WESTERN DESERT, EGYPT

Dr. K.A. Khaled*, and Dr. Abdel-Hady M.A. **

ABSTRACT

The aim of this study is to discuss the geologic history and, time relation of trap formation and hydrocarbon generation in Razzak area.

Razzak oil field represents one of the NE-SW faulted anticlinal dome-like structures within the northern part of the Western Desert in Egypt. Formation of this structural oil trap began in Coniacian time (the early stage of formation). Then the area acquired the present day structure at the end of Maastrichtian (the late stage).

The upper limit of the principal zone of oil formation oil window) is located at depth 3650m, where subsurface temperature is about 95°C. Pre-Jurassic rocks (Paleozoic) entered the principal zone of oil formation at the beginning of Cretaceous, while Jurassic source rocks seem to be entered the zone before the end of Miocene time. On the other hand all post Jurassic probaple source rocks (Neocomian, Aptian and Cenomanian sediments) so far not reached this zone in the area. Consequently, oil generation in Jurassic sediments could date back to the Miocene time after the formation of the oil trap in Razzak area.

INTRODUCTION

Razzak oil field, with many other gas and/or oil fields, are located in the northern half of the Western Desert of Egypt (fig.1) It was discovered and commercially exploited in the mid 1972's by Nile Petroleum Company (NIPCO).

This study reveals the time-temperature relation and maturation of Mesozoic sediments, inorder to, throw light upon the burial history of these sediments and the time relation of trap formation and hydrocarbon generation, in addition to the maturation degree of the sediments in this area. To achive this, the geologic history and paleotectonics which affected the area and played a significance role in the formation and development of the structure of Razzak oil field; were studied.

TYPES OF DATA AND THE TECHNIQUE USED

A complete set of different electric logs, ditch and core samples, and seismic data incorporated in this core samples, and seismic data were incorporated in this research work. Using all these data, a series of different geologic subsurface maps, paleotectonical profiles, bed to bed correlation, geothermal gradient, and burial history diagram were constructed. These will elucidate the structural elements, the development and growing of the structures, the maturation levels of the sediments and involved organic matter. Furthermore, the sedimentary sections in some wells around Razzak region, and the ideal composite log of the Western Desert are used to estimate the thickness of se-

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The percentage values of the fission products in the coating are calculated and shown in Fig. (7). These values represent the internal release of the fission products in each particle.

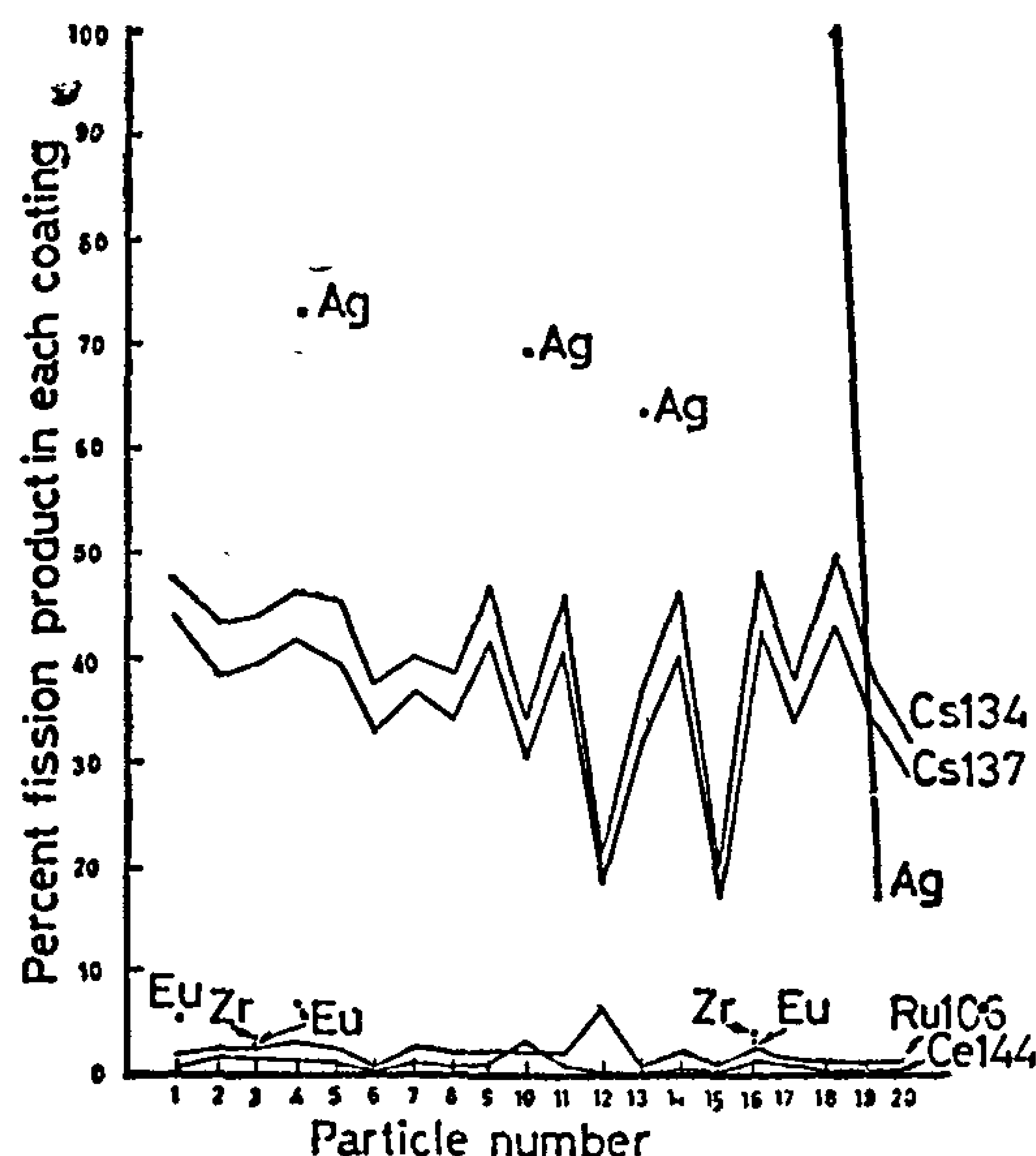


Fig.(7):Internal release in irradiated TRISO coated particles.

3. DISCUSSION AND CONCLUSION

From Fig. (7) it is clear that Cs-134 and Cs-137 gave the highest percent values in the coatings and this may be due to the fact that cesium migrates from the hot parts to the colder ones, i.e. from the kernel to the coating (14). It is obvious also that the percentage values for Cs-134 are higher than the corresponding percentage values for Cs-137, this can be explained considering the different way of their production. Cs-137 is 30.1 year ($t\frac{1}{2}$ = 30.la), with only short lived precursors, the one with the longest half life being the noble gas nuclide Xe-137 ($t\frac{1}{2}$ = 3.83 minutes). Cs-134 on the other hand, is neither directly produced by fission nor by decay, but by neutron activation of the stable Cs-133, which is not only the end product of this fifssion product decay line but also the only naturally ocuuring cesium isotope. Furthermore, the 133-decay line contains two nuclides with meduim half lives, I-133 (20.8 hours) and Xe-133 (5.3 days) as cesium precursors. The zero values for some fission products in the coatings may be due to the idea that the amounts of atoms present are below the detection limit.

One may observe also that the percent of atoms of Zr-95, Ru-106 and Eu-154 in the coatings are low and this may be due to the low diffusion rates of these fission products from kernel to the coating.

Also from Fig. (7) it is clear that the highest per cent values of Cs-134 in the coating is 48% (less than 50%) and the highest per cent value for Cs-137 in the coating 42.9% (less than 50%). These two values indicate that the fuel performance is good and it can be used as a HRGR fuel.These results agree well with the fuel specifications for HTGR (11,14).

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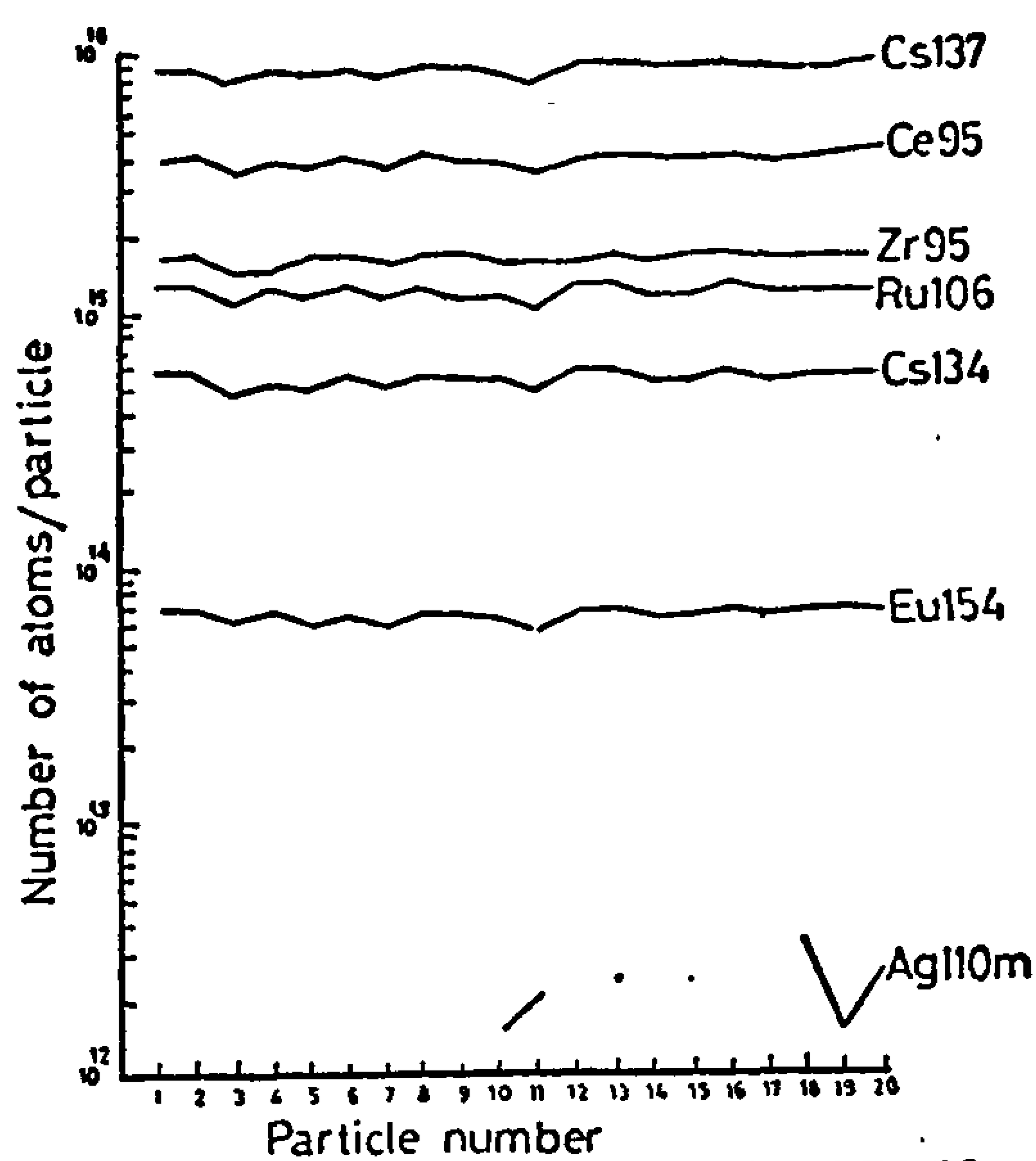


Fig.(3):Fission products in irradiated TRISO coated particles.

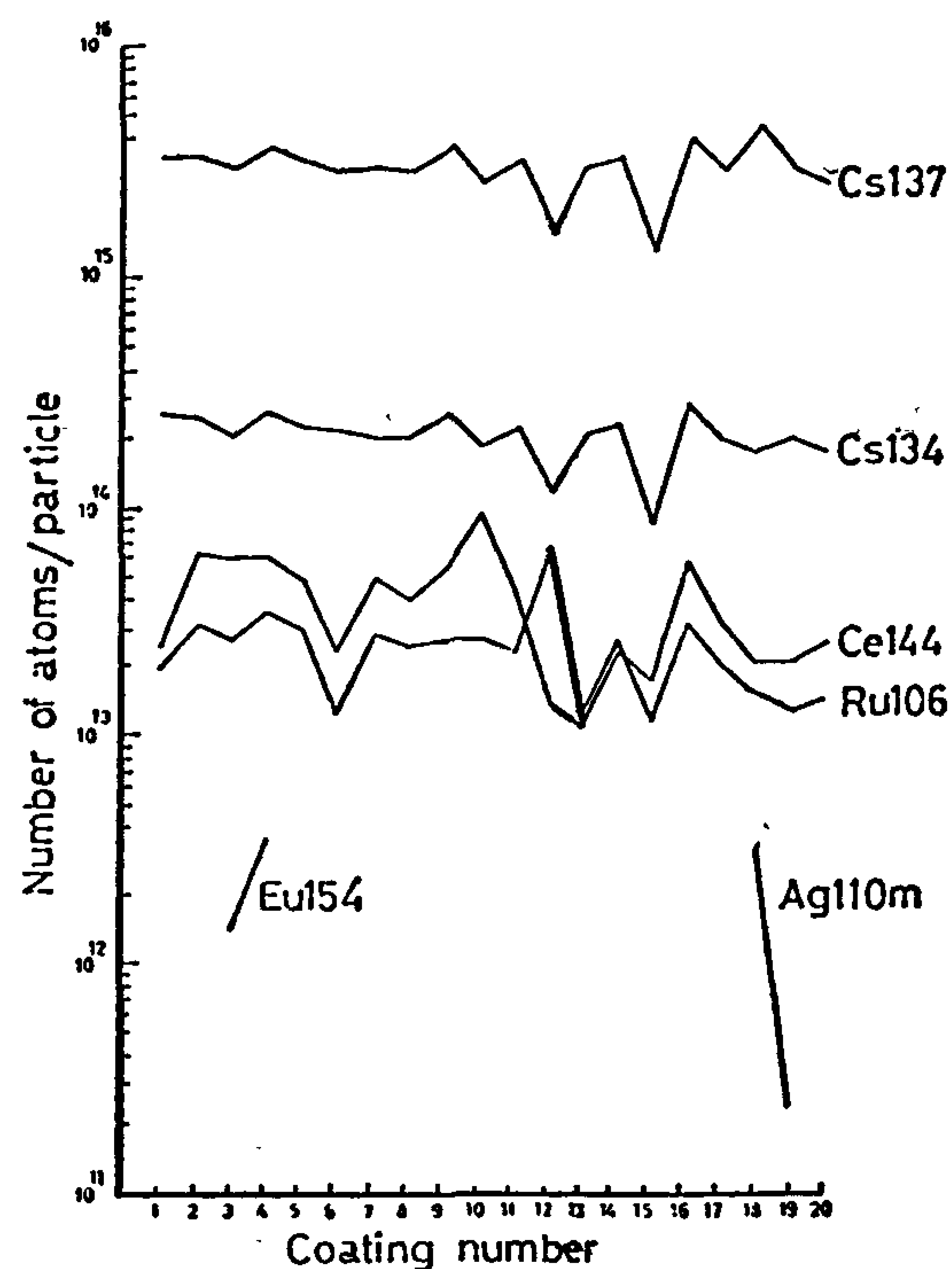


Fig.(5):Fission products in the separated TRISO coatings.

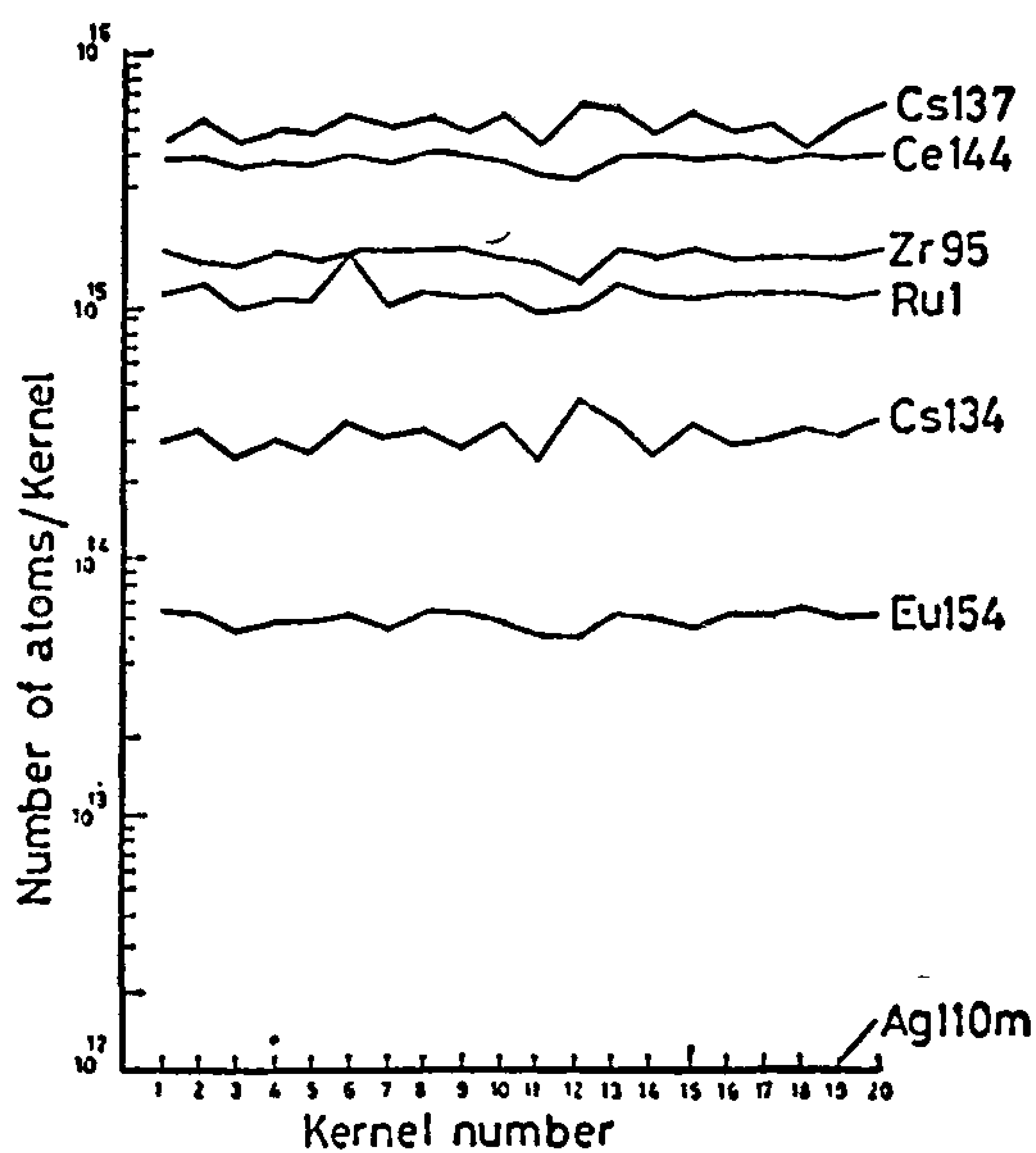
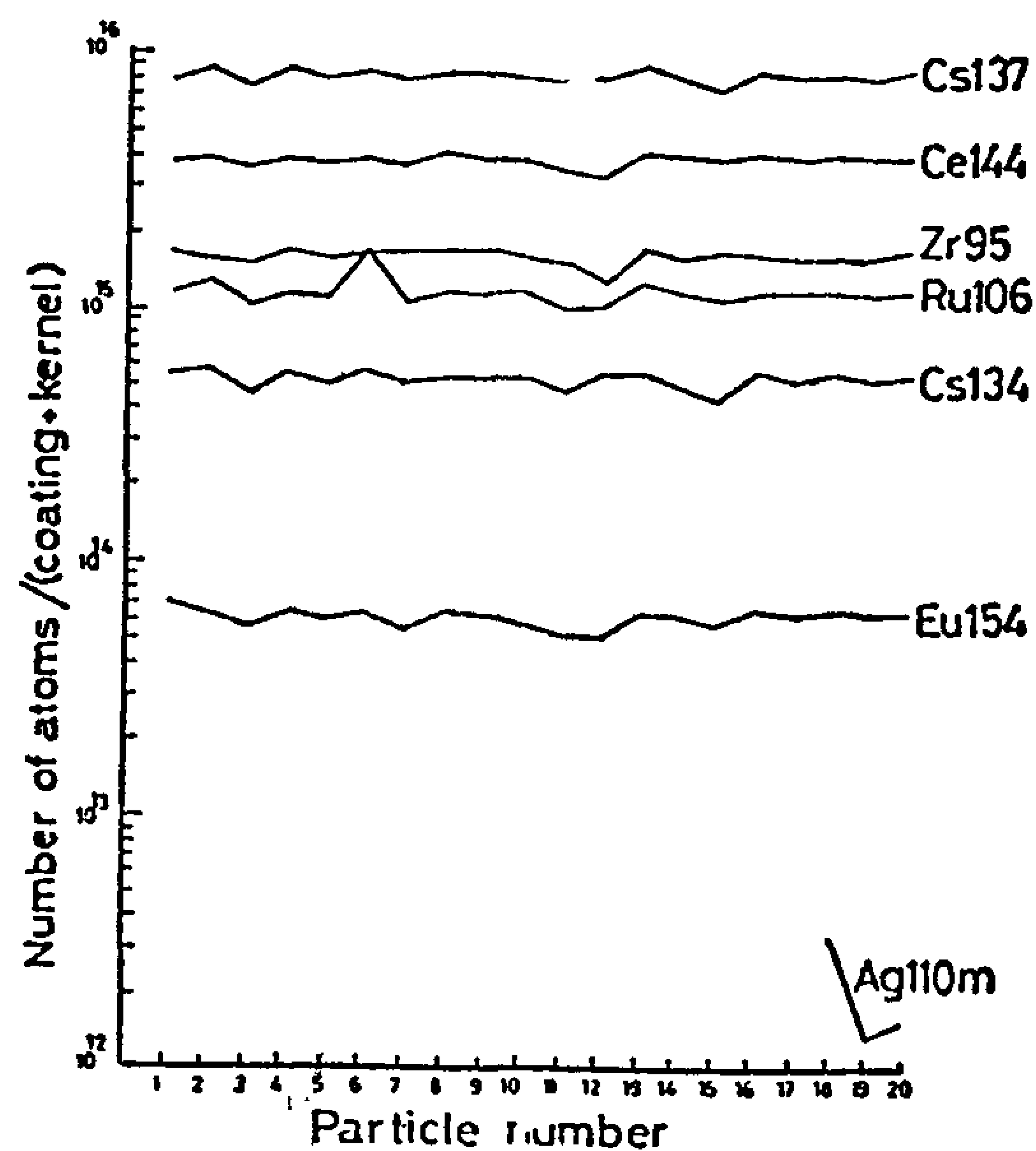


Fig.(4):Fission products in irradiated separated kernels.



Fig(6):The sum of the fission products in the coatings and kernels

The sum of the fission products for both the kernels and the coatings for each particle is shown in Fig. (6).

From Figs. (3) and (6) it is obvious that there is some difference between the values of the fission products for the same particle. The difference is obviously clear in the case of Cs-134, Cs-137 and Eu-154 while in the other elements the values are almost the same. This difference may be due to the loss of some of the coating during separation.

2.2 Gamma Spectrometric Analysis

The -spectrum for each single coated particle was achieved using the Ge-Li detector which was calibrated before and after each five runs. A Ra-226 source of 9.84 uCi activity was used as a standard source. The distance between the standard source and the the detector was 80 cms (the same distance used for the analysis of the coated particles). The efficiency of the detecor is obained from the following equation:

$$\varepsilon = E / A.\ t_m.\ \gamma$$

where:

- ε : The efficiency of the detector.
- F : Net area under the peak.
- A : The gamma activity.
- t_m : Measuring time in seconds (10000 sec in our case).
- γ : Gamma intensity (%).

The efficiency at each peak was calculated using a simple computer program (13). The input of this program is the net peak area (F), the activity (A), the distance between the source and the detector in cms and the measuring time in seconds. The efficiency (ε) at each peak is plotted versous the energy in KeV on a log-log paper, Fig. ((2). This figure shows a linear dependency with a deviation at low energy (200 KeV), and this may be due to the low resolution power of the detector in this region.

2.3 Fission Products Measurement in Irradiated Particles

The gamma spectrum for each particle was obtained and the calculation of the fission products in atoms per particle was carried out by the use of the computer program INVENTAR (13). The input of this program is the net area for each peak, the disance between the detector and the sample, in cms (80 cms in our case), the measuring time in seconds (10000 secs, in this case); two efficiencies ε_1 and ε_2 at two different energies E_1 and E_2 and the corresponding channels C_1 and C_2 (these values may be obtained from Fig. (2)), the weight of the sample in grams, the time between the end of irradiation and the measurement in days.

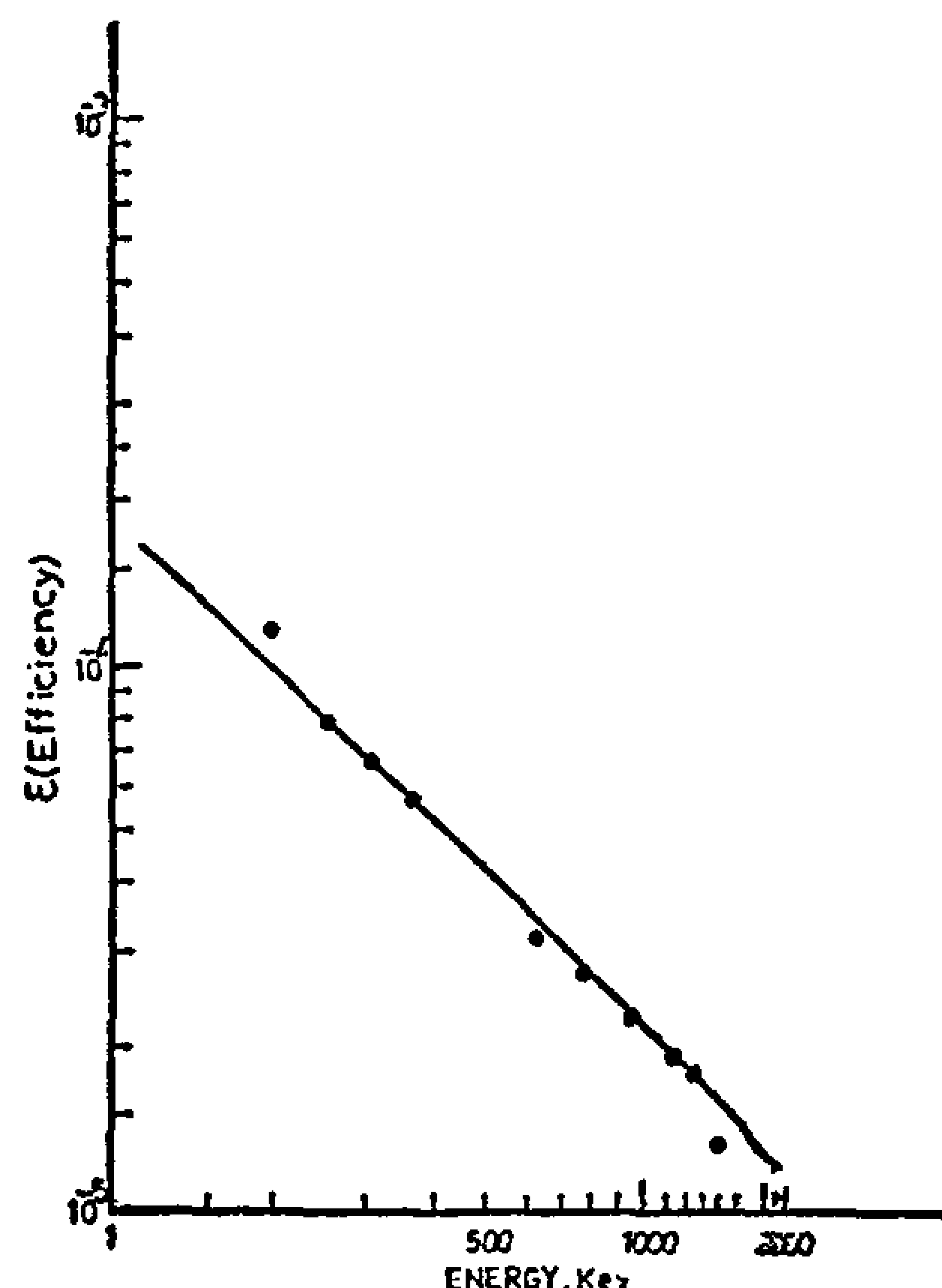


Fig.(2): Efficiency-energy diagram for Ge(Li) detector.

After measurement, coatings and Kernels were separated by pressing the particles gently between two flat silica plates. The γ-spectrum and fission products calculation were achieved for each separate coating and Kernel following the same procedure for particles.

2.4 Experimental Results

The fission products measured were Zr-95, Ru-106, Ag 110m, Cs-134, Cs-137, Ce 144 and Eu-154. The results for the twenty particles are shown in Fig. (3).

The fission products in the separated Kernels and coating in atoms/kernel and atoms coating are shown in Figs. (4) and (5) respectively.

ticles from capsule-1 compact 35, Fig. (1), as evaluated. The particle specifications are as follows:

1 — Kernel diameter = 500 μm.

2 — The coating consists of the buffer layer, inner layer, middle layer, and the outer layer with thicknesses 94, 41, 36 and 40 respectively. The buffer layer is porous pyrolytic carbon, the inner and outer layers are pyrolytic carbon while the middle layer is silicon carbide which serves as a diffusion barrier for the retention of fission produdts (12). The irradiation schedule is shown in Table (1). The average irradiation temperature was 930°C and the fuel is low enriched uranium oxide (LEU), 982% enrichment, irradiated to a burnup of 8.24% fission per initial heavy metal atom (FIMA). The capsule contains 2419 particles. The weight of U-235 before irradiation was 0.15005 g and U-238 was 1.37795 g. The average neutron flux was 0.985 X 10^{14} neutrons/ $cm^2 \cdot S$.

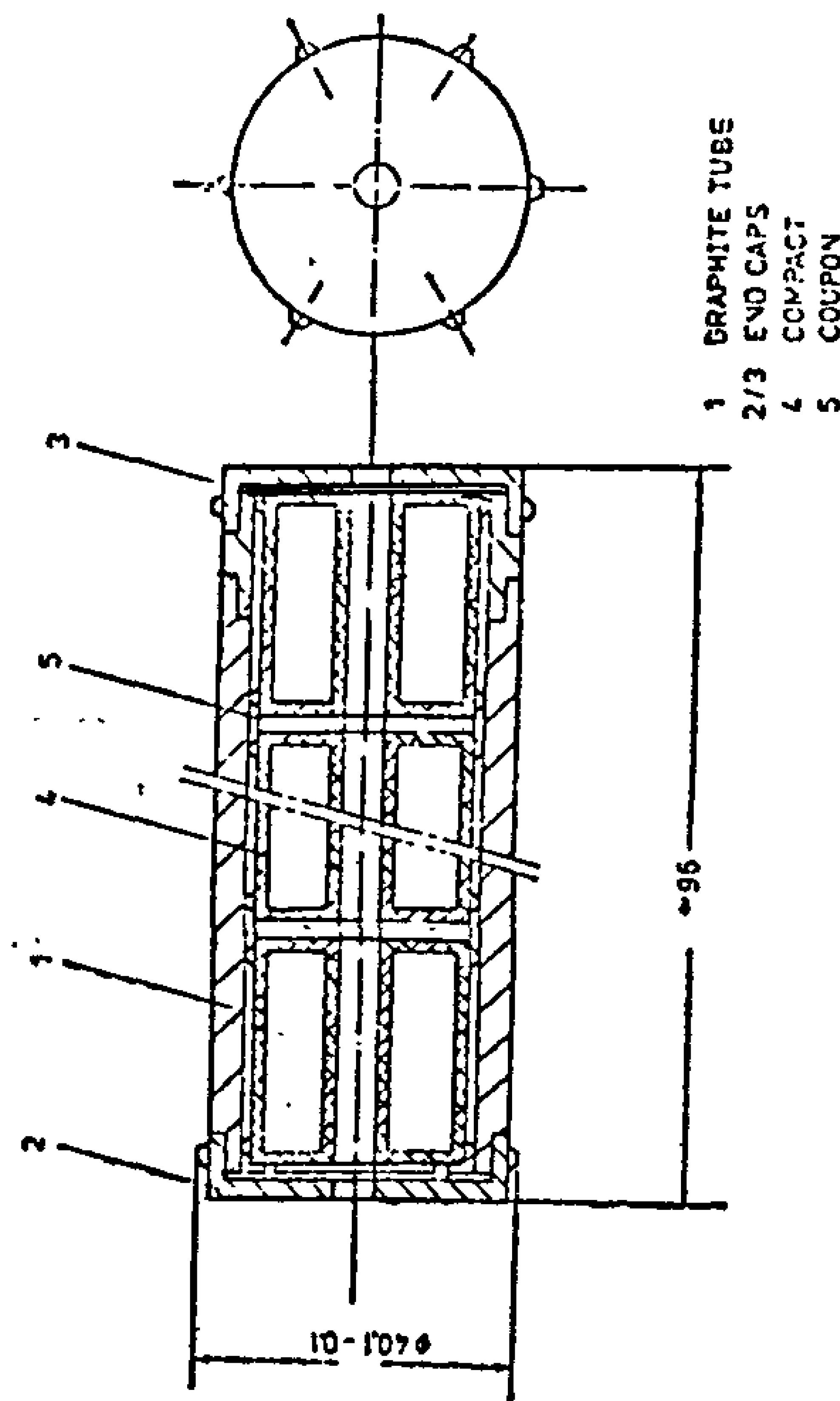


Fig. (1) : Compact 35. Capsule 3

Table (1) : Irradiation schedule for capsule (1).

Cycle	Irradiation time, days		Neutron flux X 10^{-14} (cm^{-2} s^{-1})
	Operation	Pause	
1	23.82	7.96	1.066
2	28.04	4.96	1.905
3	10.04	3.99	1.16
4	22.04	5.91	1.155
5	12.03	1.88	1.054
6	15.06	6.04	1.054
7	16.1	4.9	0.994
8	9.1	2.92	0.887
9	1.0	28.98	0.887
10	28.89	6.14	0.775
11	2.86	1.60	0.852
12	18.48	5.13	0.852
13	9.82	7.23	0.870
14	7.79	1.94	0.989
15	10.10	5.02	0.989
16	6.64	1.57	1.049
17	14.77	4.92	1.049
18	23.13	-	0.950

Σ days 259.71

2.1 Capsule Deconsolidation

After irradiation the capsule was allowed to cool down in a can under water for a suitable time. The deconsolidation of the fuel element was carried out inside the hot cell to separate the irradiated coated particles from the graphite matrix. An electrochemical cell was used for this purpose. The fuel element served as the anode. The electrolyte was 2 molal HNO3 and the current density was 0.5 A/cm^2 (11,12). Twenty particles were sampled out and each one was kept separately in a can.

FISSION PRODUCTS RELEASE FROM COATED PARTICLES

BY

M.A.A. El-Masry and A.N. Mahdy

Summary

In order to determine the internal fission product release, i.e. in cooled fuel particles, the release from the kernel into the coating for 20 particles from a disintegrated compact were measured. The distributions of the fission products between the coatings and the Kernels were calculated. It was found that Cs 137 and Ag 110m have the highest internal release values. For all other fission products, except Ru 106 and Ce 144, the internal release was mostly below the limit of detection.

1 INTRODUCTION

Information about fission products release in high temperature gas cooled reactor (HTGCR) is of great importance for both normal reactor operation and transient conditions (1,2). The effect of oxygen to metal ratio and the mechanisms of fission products release have been investigated (3,4,5,6,7).

The problem at hand was the measurement of the distribution of solid fission products between the coatings and the Kernels in TRISO coated particles. Fission products measurements inportance lies in the fact that they are used as burnup monitors. Mass-spectrometric and Y-spectrometric methods may be used in this kind of measurements. The Y-spectrometry technique is based on the high resolution power of a lithium drifted germanium detector [Ge(Li)] (8), which is connected to a multichannel analyzer and the latter to a computer. The intensities of γ rays measured are usually determined by calculating the counts in the full energy peaks produced by the radiations in question.

The non-linear base line construction method was used to get the exact peak area (9,10). A short computer routine was written to calculate the coefficients of the polynomial and hence the peak area.

Transport behaviour and release of fission products from irradiated particles is very important. The only fission products that release from the fuel kernels are Sr 90, Ag 110m, Cs 134, Cs 137 and palladium isotopes. The internal fractional release, i.e. the release from the kernel to the coating, is calculated from the equation:

$$f_i = f_k - f_p$$

where:

f_i = internal fractional release.

f_k = fractional release from the Kernel.

f_p = fractional release from the particle.

This can be achieved experimentally by measuring the amount of fission products in the coated particle, kernel and coating, (after separation from the particles). From these values the ratio between the fission products in the coating and the kernel is calculated.

2-EXPERIMENTAL

In this investigation the internal release for twenty irradiated TRISO coated par-

The equation of Arieli and Mukherjee does not consider the effect of gauge length on the fracture strain, although this is very important in determining the value of the fracture elongation.

It can be seen from the present review that there are many important parameters which were not considered in the equations discussed and thus none of the existing equations can be used to give the correct value of fracture strain for the superplastic materials.

5. CONCLUSIONS

1. Although the strain rate sensitivity «m» is an important parameter for a superplastic materials, it is not sufficient for the prediction of the fracture strain.

2. Most of the equations discussed in the present work neglect the effect of specimen gauge length and surface condition (presence of a notch).

3. The effect of temperature and grain size was not considered in all of the equatiois included in the present review.

4. None of the existing theoretical and empirical treatments can be used to predict the correct value of fracture strain of superplastic materials.

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diction of the fracture elongation of sheet specimens of Ti-6 Al-4V. For a flat specimen, localized necking and failure can only occur by thinning without any lateral contraction[20]. Thus they state that the total elongation is an inverse function of the width to thickness ratio. Their proposed equation for the prediction of fracture elongation is :

$$\varepsilon = [\frac{(B\ m_f)}{(W/Y)}]\ 100 \qquad (17)$$

where B is a material constant equal to 32 for Ti-6 Al-4V,m_f is the terminal value of the strain rate sensitivity, and w,y are the gauge width and thickness, respectively.

4. DISCUSSION

The equation of Avery and Sturat[12] is derived essentially for smooth specimens and does not take into account any stress concentration which is present in the tapered and notched specimens. Also, this equation does not include the elongation resulting from neck development up to fracture (i.e., as β gets very small [8]). According to Morrison [8], the Avery and Stuart equation can be used to determine the total elongation at fracture when the contribution of necking to the total elongation is small. There are many factors which affect fracture strain in superplastic materials but they are not considered in the analysis of Avery and Stuart. Examples for these fractors are temperature and grain size.

Burk and Nix equation considers only the strain rate sensitivity 'm' in the prediction of fracture elongation, and this leads to similar values of fracture strain for all geometries. Thus, it is concluded that the "m" value is an important factor but not sufficient for prediction of fracture strain. Also, this equation ignors the possibility of cavity nucleation, thus, equation (8) should give an upper limit for the precentage elongation.

Mohamed modified the Burk and Nix equation and arrived at equation (9). This equation also ignors the effect of gauge lengh.

In the treatment of Ghosh and Ayres which gave eqation (11), there will be no difference for fracture strains of notched and tapered specimens having the same value of "f". In other words, the gradient of variation has not been considered in equation (11).

The equation of Pavinich and Raj (14) distinguishes between notched and tapered specimens through the value of ε_{lb} and it predicts a lower value for the notched specimen which is in accordance with the experimental trend. It should be mentioned that some of the assumptions in the theory. such as the existance of holes on boundaries perpendicular to the stress axis or an increase in the inhomogeneous part of deformation with increasing «m». are not strictly applicable to superplastic materials.

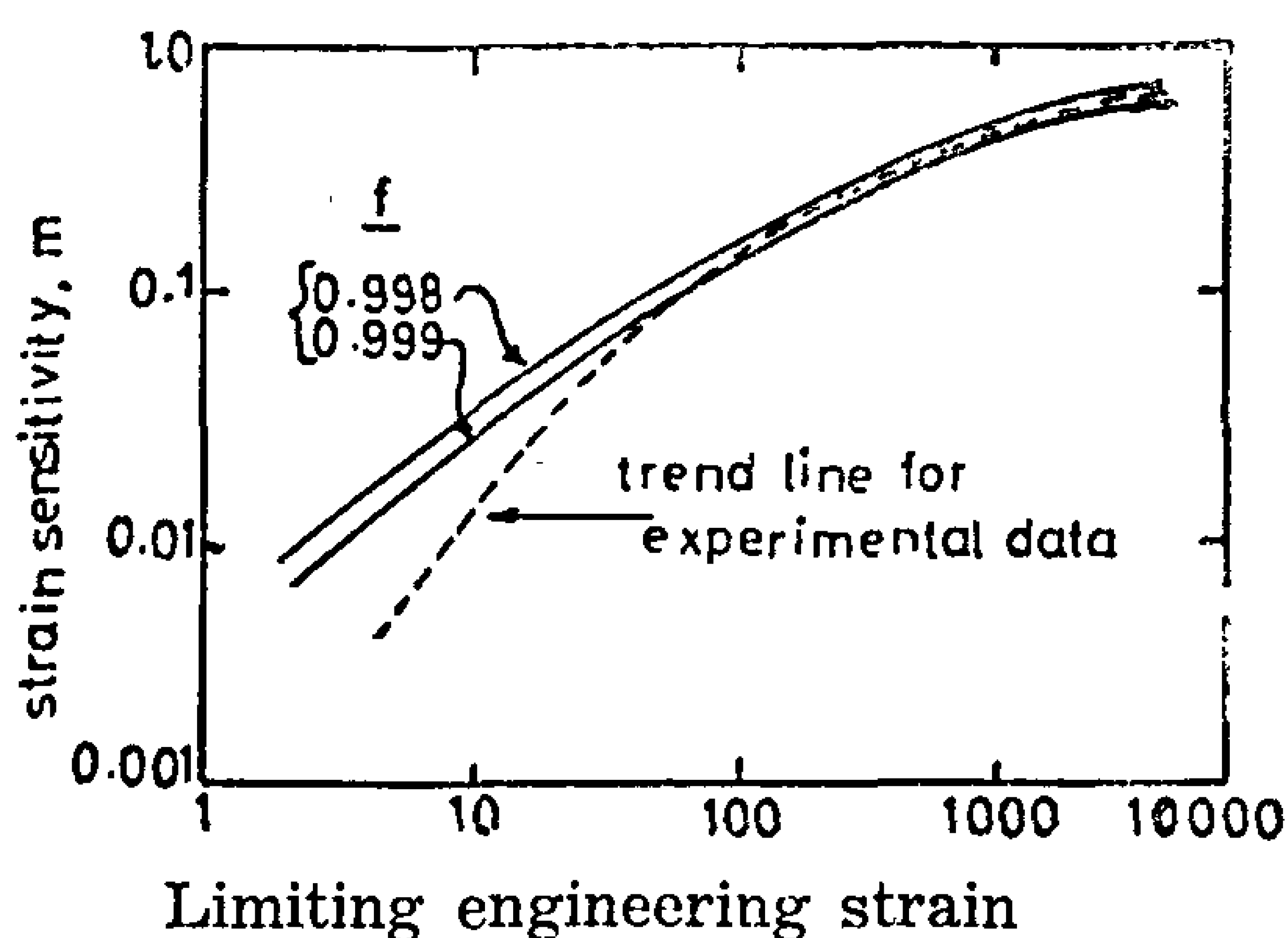
By examining the approach of Morrison it can be noticed that this equation is valid only if deformation takes place by the gradual growth of a neck. It is suggested therefore that this equation is not valid when do/Lo is very small (less than 0.1), since in this case several necks may develop. Also, when do/Lo) is large ($>$0.5) equation (16) should not be used due to end effects. Since «m» varies during the test, care is necessary concerning the correct value of «m». Morrison [8] suggested that the minimum value of «m» should be used in equation (16).

Morrison equation gives no difference in fracture elongation for notched and tapered specimens. This was not supported by experiments. Therefore, it is concluded that the Morrison equation is not appropriate for the prediction of fracture elongation of tapered and notched specimens where deformation is initiated in the center of the specimens.

tion, $\varepsilon_i > \varepsilon_h$ deformation continues until ε_i reaches the fracture strain. Rearranging and integrating equation (10), the limit strain for superplastic materials is given by equation (11).

$$\varepsilon^{*} = -m \ln[1-(1-f)^{\frac{1}{m}}] \qquad (11)$$

The values ε^* calculated for different values of "f" are shown in Figure (2) together with the experimental results of Woodford [17].



Limiting engineering strain

Fig. (2) : Engineering strain as function of "m" for two different values of"f".

2.4 Equation of Pavinish and Raj[18]

Pavinish and Raj [18] derived equations for the upper and lower bounds of ductility for an intergranular mode of fracture. In their analysis, they assumed that the total strain is composed of an inhomogenous strain in the region of cavities and homogenous strain in the region far from the cavities, so that :

$$\varepsilon = \left(\frac{\alpha_2 I_h}{\bar{L}}\right)(\varepsilon' - \varepsilon'') + \varepsilon'' \qquad (12)$$

where α_2 is a constant, I_h is the hole spacing, $\bar{L}$ is the mean linear intercept grain size and ε', ε'' are inhomogenous and homogenous strains, respectively.

The lower bound of ductility occurs when there will be completely localized deformation where $\varepsilon = 0$ and $\alpha_2 = 1$.

$$\varepsilon_{1b} = \left(\frac{I_h}{\bar{L}}\right)\varepsilon' \qquad (13)$$

The upper bound of ductility or fracture strain ε_f was obtained by analyzing data obtained on a Cu-Si solid solution alloy, and the result is given by :

$$\varepsilon_f = \varepsilon_{1b} \cdot e^{\left[\frac{4}{(n-1)}\right]} \qquad (14)$$

where n is the stress exponent.

3. EMPIRICAL EQUATIONS FOR PREDICTION OF FRACTURE STRAIN

3.1 Equation of Morrison [8]

When failure is due to necking in a tensile test, the total elongation depends on the ratio of the initial diameter, d_o, to the initial gauge length, L_o, of the test specimen. For low strain rate sensitivity, alloys, this is given in the form :

% elongation

$$= C_1\left(\frac{d_o}{L_o}\right) 100 \qquad (15)$$

where C_1 is a material constant.

For superplastc materials, the strain rate sensitivity, m, should also be considered in any equation relating fracture elongation to specimen geometry. Morrison [8] used data from a lead-tin alloy to obtain a square dependence of elongation on "m", so that :

% elongation

$$= C_2 m^2\left(\frac{d_o}{L_o}\right) 100 \qquad (16)$$

where C_2 is a material constant approximately equal to 280 for lead-tin alloy.

3.2 Equaton of Arieli and MuKherjee[19]

A similar equation has been proposed byArieli and MuKherijee[19] for the pre-

$$\int_{A_o}^{A} A^{[(1-m)/m]}\, dA = \int_{\alpha A_o}^{\beta A_o} A^{[(1-m)/m]}\, dA \quad (4)$$

$$A = \left[\frac{(1-\alpha^{(\frac{1}{m})})}{(1-\beta^{(\frac{1}{m})})}\right]^m A_o \quad (5)$$

The percent reduction in area for development of an initial neck αA_o to final neck βA_o is :

$$\%RA = \left\{1-\left[\frac{(1-\alpha^{(\frac{1}{m})})}{(1-\beta^{(\frac{1}{m})})}\right]^m\right\}100 \quad (6)$$

For superplastic materials :
% elongation

$$= \left\{\left[\frac{(1-\beta^{(\frac{1}{m})})}{(1-\alpha^{(\frac{1}{m})})}\right]^m - 1\right\} \quad (7)$$

Figure (1) shows the variation of elongation with α for a final area variation of 10% (β = 0.9) for different values of "m".

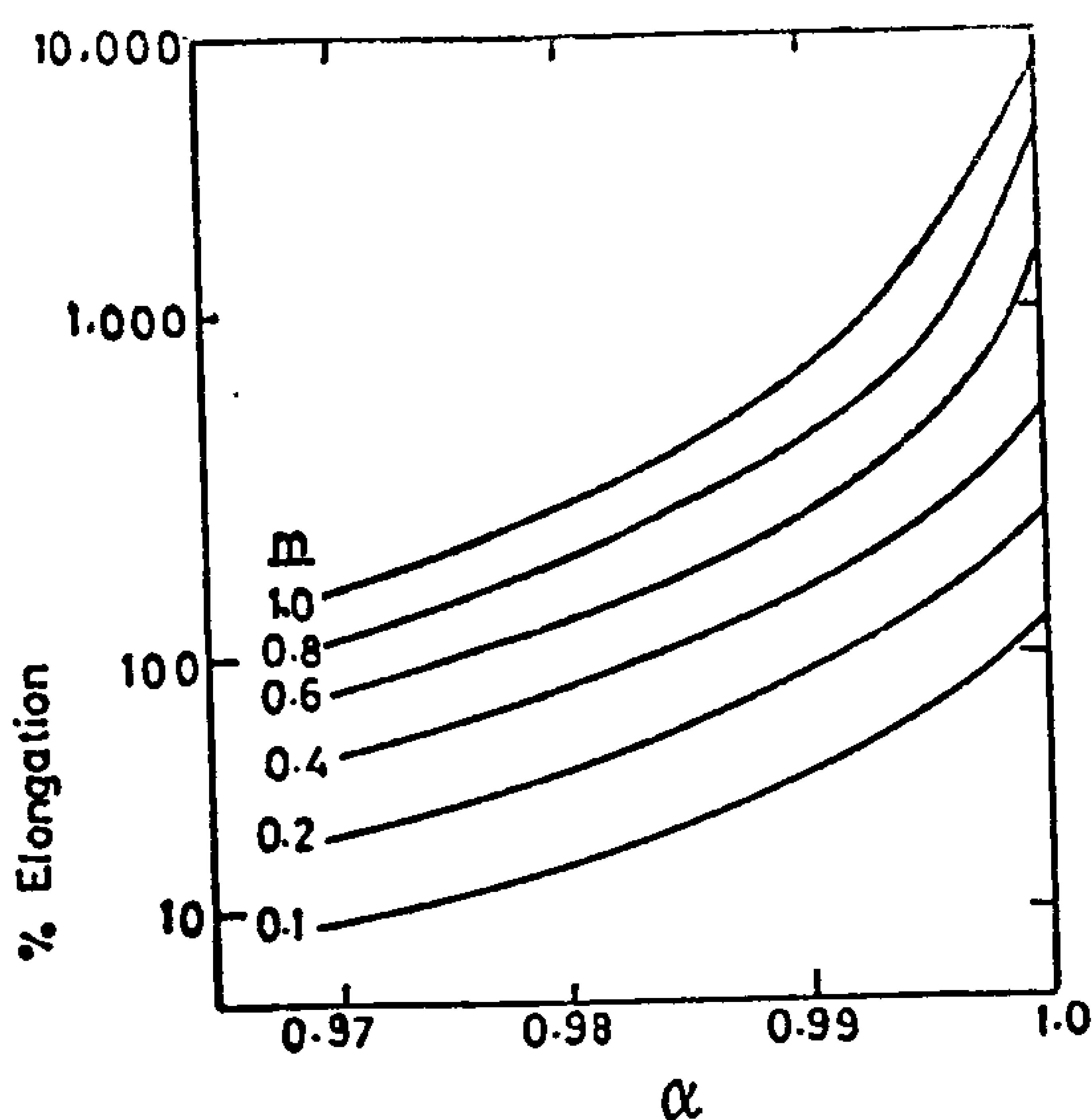


Fig. (1) : Variation of elongation with α for a final area variation of 10% (β =0.9) for different values of "m".

2.2 Equation of Burke and Nix [13]

Assuming a specimen with non-uniform cross section and ignoring the effect of strain hardening and void and crack formation, also assuming a non-uniform temperature along the gauge legth, Burk and Nix [13] numerically analyzed the development of non-uniformities during creep. It was later suggested that the fracture strain can be obtained from this approach, and it is given by an equation of the form:

$$\varepsilon_f = \frac{m\ K}{(1-m)} \quad (8)$$

where K = 2-3. The validity of this equation was confirmed by the experimental work of Lund and Nix [14].

Since the Burke and Nix [13] theory ignores the possibility of cavity nucleation, equation (8) should give an upper limit for percentage elongation. Mohamed [15] modified the Burke and Nix equation and arrived at the following relationship :

$$\%\varepsilon_f = \left\{\exp\left[\frac{m\ K_2}{(1-m)}\right]-1\right\} 100 \quad (9)$$

where K_2 is constant.

2.3 Equation of Ghosh and Ayres [10]

Ghosh and Ayres [10] used a limit strain analysis method developed by Marciniak [16] to derive the fracture strain. Assuming an inhomogeneity in the original sample and a constitutive low as in equation (1), they derived an equation by considering load equilibrium between the homogenous and inhomogenous regions of the sample :

$$\exp(-\varepsilon_h)(\dot{\varepsilon}_h)^m = (1-f)\exp(-\varepsilon_i)(\dot{\varepsilon}_i)^m \quad (10)$$

where ε_h and ε_i are true strains in the homogenous and inhomogenous parts of the sample (1-f) is the ratio of cross-sectional areas in the inhomogeneity to that outside it. At the beginning of deforma-

THE PREDICTION OF FRACTURE STRAIN IN SUPERPLASTIC MATERIALS

Mohamed Mamdouh Ibrahim Ahmed*

1. INTRODUCTION

The importance of superplastic materials is due to their high value of fracture elongation which enables their economical use in forming processes. Earlier investigations have shown that the fracture elongation in superplastic materials depends on grain size [1], temperature [1-3], strain rate, rate of cavitation [2,4,5], specimen size [6], specimen geometry [6,7]. and surface condition [8].

Despite many investigations, there is no unique equation to predict the fracture strain in superplastic materials. Many attempts have been made to develop an equation for this prediction. One of the parameters which has an important effect on the fracture strain of superplastic materials is the strain rate sensitivity, «m» There is considerable controversy on the value of «m» which should be used in the various equations [9,10]. However, it seems reasonable to use the value of "m" of high strains close of fracture in those equations which predict the fracture strain [11].

The major equations that predict fracture elongation for superplastic materials will be described in the following parts. These equations will be reviewed and discussed.

THEORETICAL EQUATIONS FOR PREDICTION OF FRACTURE STRAIN

2.1...Equation of Avery and Stuart [12]

For superplastic materials, the stress 6 and strain rate $\dot{\varepsilon}$ are related as :

$$\sigma = K \dot{\varepsilon}^{m} \qquad (1)$$

where K is a constant and m is strain rate sensitivity. This equation, if expressed in terms of area and rate of change of area, becomes :

$$\left(\frac{dA}{dt}\right) = -\left(\frac{P}{K}\right)^{\frac{1}{m}} \left[\frac{1}{A^{(1-m)/m}}\right] \qquad (2)$$

where P is the load which does not vary along the specimen and is a function of time only. Avery and Sturat [12], assuming constant values of m and K, integrated equation (2) to obtain :

$$\int_{A_0}^{A} A^{[(1-m)/m]} dA = -\int_{t_0}^{t} \left(\frac{P}{K}\right)^{\frac{1}{m}} dt \qquad (3)$$

If the initial area variation along the length is from A_0 to αA_0, then, the final area elements vary from A to βA such that :

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RAW MATERIALS & CHEMICAL INDUSTRIES

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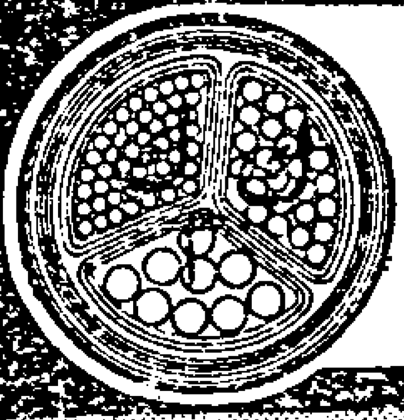
مكتب بيع الأسمنت المصرى

شركات أسمنت طره / حلوان / الإسكندرية / القومية / أسيوط

دور نشاط مكتب بيع الأسمنت المصرى

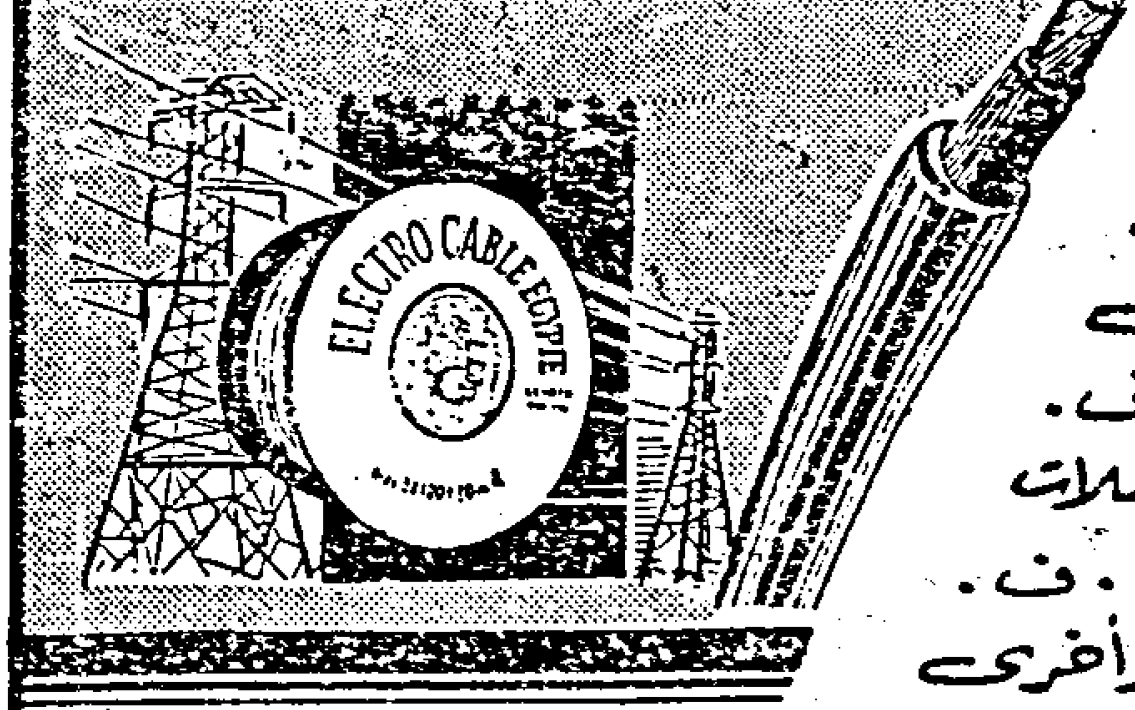
١. تنظيم تسويق الأسمنت المصرى المنتج محليا فى داخل الجمهورية وتصدير الفائض للأسواق الخارجية
٢. تنظيم سحب إنتاج شركات الأسمنت طبقا للمعدلات والطاقة الإنتاجية .
٣. توفير إحتياجات البلاد من الأسمنت المستورد فى حالة قصور الإنتاج المحلى عن الوفاء بإحتياجات البلاد .
٤. تدبير وسائل النقل المختلفة بالسيارات والسكك الحديدية والوحدات النهرية لتنظيم سحب إنتاج الأسمنت وتوزيعه على كافة بلاد الجمهورية يوميا والتصدير للخارج على البواخر وسحب الأسمنت الوارد للموانى المختلفة إلى داخل البلاد
٥. إدارة اسطول النقل بالسيارات المملوك لشركات الأسمنت بجراجات الضاحية والجيزة بأحدث المعدات فى كل من القاهرة والإسكندرية وأسيوط .
٦. إدارة أجهزة البيع والتسويق والنقل والتصدير والإستيراد بكافة وظائفها وفروعها بالقاهرة والإسكندرية والمنصورة والإسماعيلية وأسيوط .
٧. إستيراد بعض مستلزمات شركات الأسمنت من الورق الكرافت اللازم لصناعة أكياس التعبئة وخلافه
٨. تقديم الصهاريج اللازمة للعملاء لإستخدامات الأسمنت السائب .
٩. تسويق حديد التسليح المحلى والمستورد الخاص بوزارة الإسكان
١٠. التنبؤ بمستقبل صناعة وإنتاج الأسمنت وتسويقه

مع دوام التقدم لتحقيق الإكتفاء الذاتى والتصدير للخارج والله ولى التوفيق



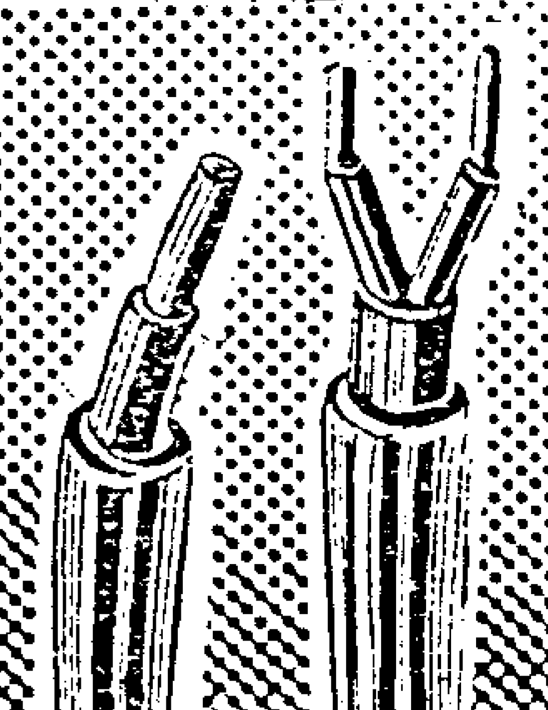
شركة الكابلات الكهربائية المصرية

تقدم بكل فخر





١. كابلات ضغط متوسط معزول بالبوليثلين المتشابك حتى ضغط ٣٣ ك . ف.
٢. كابلات ضغط متوسط معزولة بالورق المشبع بالزيت ومسلحة حتى ١١ ك . ف.
٣. كابلات كهربائية أرضية مسلحة بموصلات نحاس أو ألومنيوم ضغط ١ ك . ف.
٤. كابلات تليفونية معزولة بالورق وأخرى معزولة بالبوليثلين ومحقونة بجيلى البترول.
٥. أسلاك معزولة بالورنيش من جميع المقاسات من النحاس أو الألومنيوم.
٦. الأسلاك والكابلات المعزولة بالبلاستيك بموصلات نحاس أو ألومنيوم.
٧. الأسلاك والكابلات المعزولة بالمطاط .
٨. الموصلات الهوائية العارية نحاس / ألومنيوم .
٩. أسلاك إيريال التليفزيون الملون. ١٠. الكابلات البحرية .
١١. أسلاك لف طلمبات مياه الأعماق حتى قطر ٣ مم.



الإدارة والمصانع : مسطرد كيلو ٤ طريق ترعة الإسماعيلية - القليوبية - ص.ب ٨٠٢ القاهرة
تليفون سويتش : ٦٥١٨٢٢ - القطاعات التجارية ٨٥٠٠-٦٥٠ تلكس : CABGPT UN ٩٢٦٨٩/٢٢٢٤٨ فاكس ٩٥١١٠٣

With respect to adhesion wear, in this study, athough it occurs it seems to be rare.

Mechanical properties of abrasive grains as affecting grinding performance.

The grinding process using a grinding wheel is the sum of the high speed cutting actions by indiviual grains on the wheel. Besides, it should be considered that the bonding material and the pores in a wheel, as well as the grinding fluid, play important roles in the grinding process. Generally speaking, it is desirable that the abrasive grains have small specific wear volume and also low coefficient of friction with the work mterial-grinding for a will be small as the coefficient of friction is small, resulting in low heat generation during grinding. Also, abrasive grains provided with suitable friability are desirable, corresponding to the mechanical properties of work materials.

The compatibility of abrasive grain to the kind of grinding can be axplained by the patterns of edge fracture characteristics already shown in fig. 2. Type I grains, with higher edge strength, will be suitable for heavy grinding, where self-sharpening action does not play an important role, Type II is useful for rough grinding using a precision grinding machine, while type III should be used for finish grinding. In addition, type III abrasive grains are also recommended for grinding of hard material, because of their self-sharpening action accompanied by frequent fracture.

Variation of wheel surface with the progress of finish grinding is considered as being where the micro-fracture of cutting edges of abrasive grains on a wheel may occur frequently for some time after dressing (1st step), but its wear soon becomes dominant with less fractures because the edge of abrasive grain changes into a shape hard to crush (2nd step) and, at last, glazing occurs (3rd step) . In some cases of rough grinding, the self sharpening action is continued without reaching the 2nd step.

On the other hand, macro cracks developed on the worn surface of abrasive grains, as shown in figure 10, may have an important meaning in relation with the self-sharpening action, in view of the fact that the plateau area on the top of the cutting edge decreases trough the process of its falling off partially due to crack growth(4). Grain C is higher in thermal shock resistance than alumina grain and is hard to crack. If grain C is used against steel, its high wear volume, high edge strength and the fact that it is hard to crack readily cause glazing of the grinding wheel. In selection of abrasive grains suitable for various work materials, a higher attrition resistance is desirable, keeping balance with suitable friability. The fact that result in figures 6,8, and 9 are in agreement with the actual experiences where in alumina grain, grain C, and grain AZ40 are found suitable for mild steel, cast iron and stainless steel respectively, suggests that the wear characteristics can serve as an important lead in the selection of appropriate abrasive grains. Selection standards of abrasive grains should be considered in response to work material, grinding condition and grinding accuracy.

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sliding velocity increases, but it occurs very seldom on the worn surface of grain C. This is probably because grain C has a higher thermal shock resistance than grain A. Figure 10 shows also the worn surfaces of other abrasive grains after etching. Some cracks are seen on the worn surfaces of all alumina grains, except grain R62. Cracks in grain WA are numerous and the largest among all grains tested.

Discussions and Conclusions

Wear Mechanism of Abrasive Grains

The following wear mechanisms will be considered in abrasive grains having hard and brittle characteristics

1) Micro-fracture due to local stress concentration or local thermal shock.
2) Abrasive wear due to scratching with hard particles.
3) Corrosive wear due to chemical reaction.
4) Adhesion wear.

Wear mechanism mentioned above in 1) seems to be governed by temperature on the sliding surface. It is considered that the hardness and brittleness of abrasive grains decreas with the frictional temperature rise on the sliding surface as the sliding velocity increases. Therefore, such wear due to brittle fracture occurs easily at low sliding velocity. In addition, micro-fracture due to thermal shock may be accelerated during practical grinding because the abrasive grains on a grinding wheeel are exposed to intermittent friction.

When wear tests of grain C were conducted under wet conditions while pour-water into the slinding surface, the wear found to be 2-3 times larger than those in air, though the friction force in the former decreased to half the value of the latter. This fact shows that the wear due to thermal shock is dominant in the wear mechanism of hard and brittle materials.

In this study, the wear mechanism mentioned in 1) seems to exist in the cases which show relatively high wear rate at the low sliding velocity as shown in grain C of figure 8, and grains C, A and R62 of figure 9. As mentioned above, the hardness and brittleness of abrasive grain decreases as the slinding velocity increaeses, therefore the abrasive wear by hard particles in the disk material mentioned above in 2) is accelerated. On the other hand, corrosive wear increases with increasing sliding velocity, as a result of high surface temperature. It is generally considered that the increase of wear rate with increasing sliding velocity is due to these wear mechanisms.

Fig. 10 (a) Worn out surfaces of various abrasive grains.

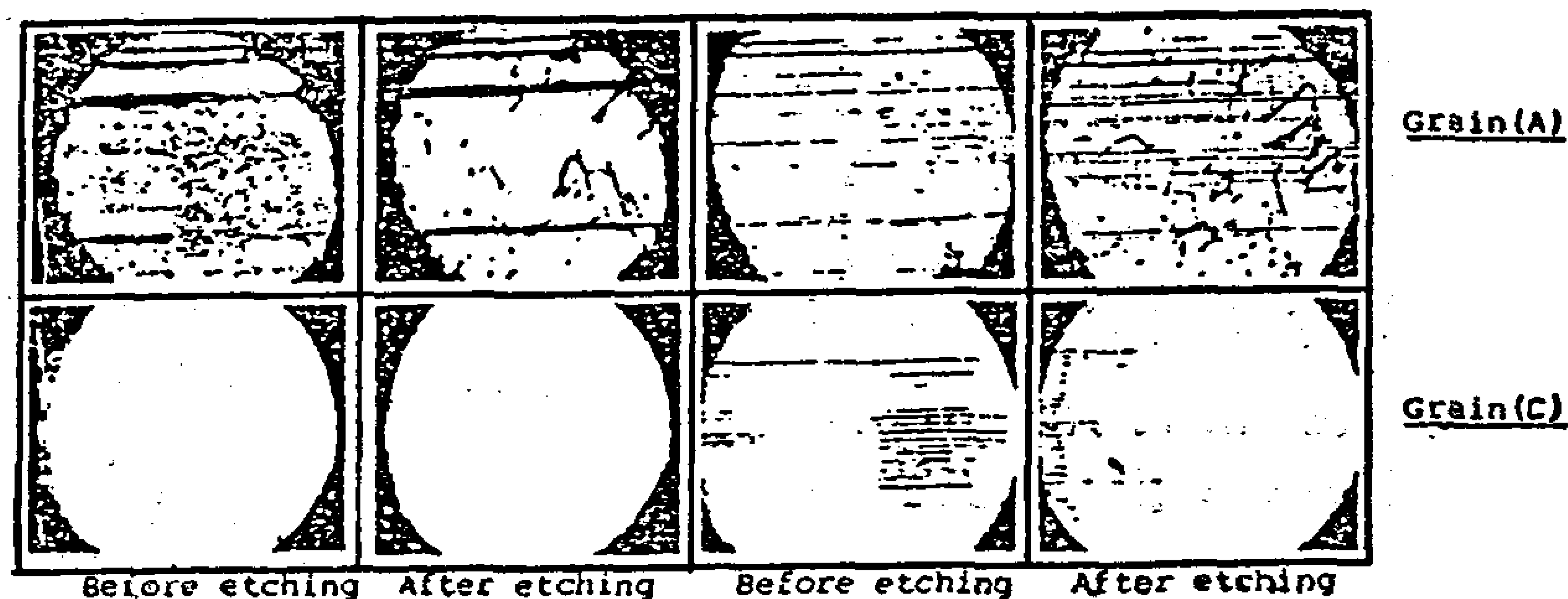
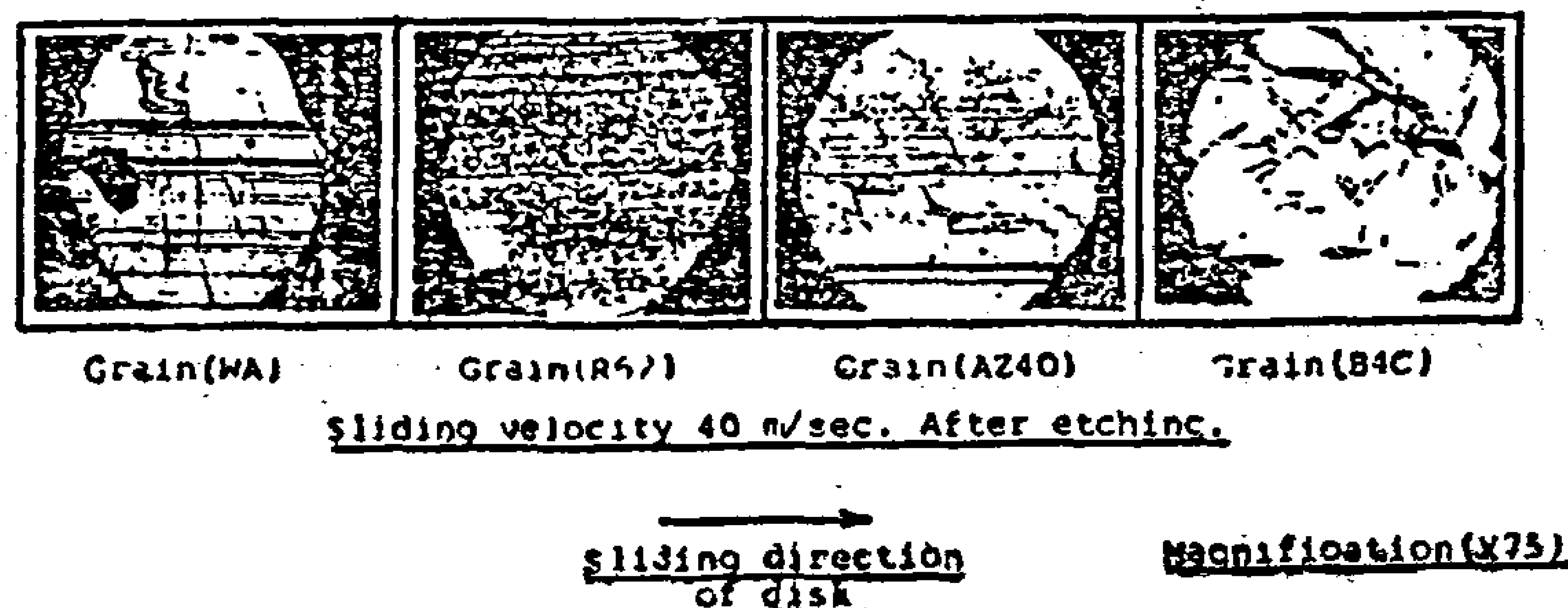


Fig. 10 (b) Worn out surfaces of various abrasive grains.



Figures 8 and 9 gives results obtained from experiments using cast iron and stainless steel disks respectively. The average K value of grain C becomes smaller than that of abrasive grains AZ40, R62 and A when the sliding velocity is beyond about 15 m/sfor cast iron and stainless steel. In the case of wear tests against stainless steel, the K values of grain A were scattered. This seems to be caused by the adhesion phenomena of stainless steel. However, the K value of grain AZYO were not scattered, this may by the reason why grain AZ40 is suitable to stainless steel. The specific wear volume of abrasive grains against stainless steel are roughly five times larger than that against mild steel and cast iron. Relations between coefficient of friction and sliding velocity shown in figures 8 and 9 are very similar to the case of mild steel shown in figure 6. Coefficient of friction for grain C is always the largest among all kinds of of abrasive grains.

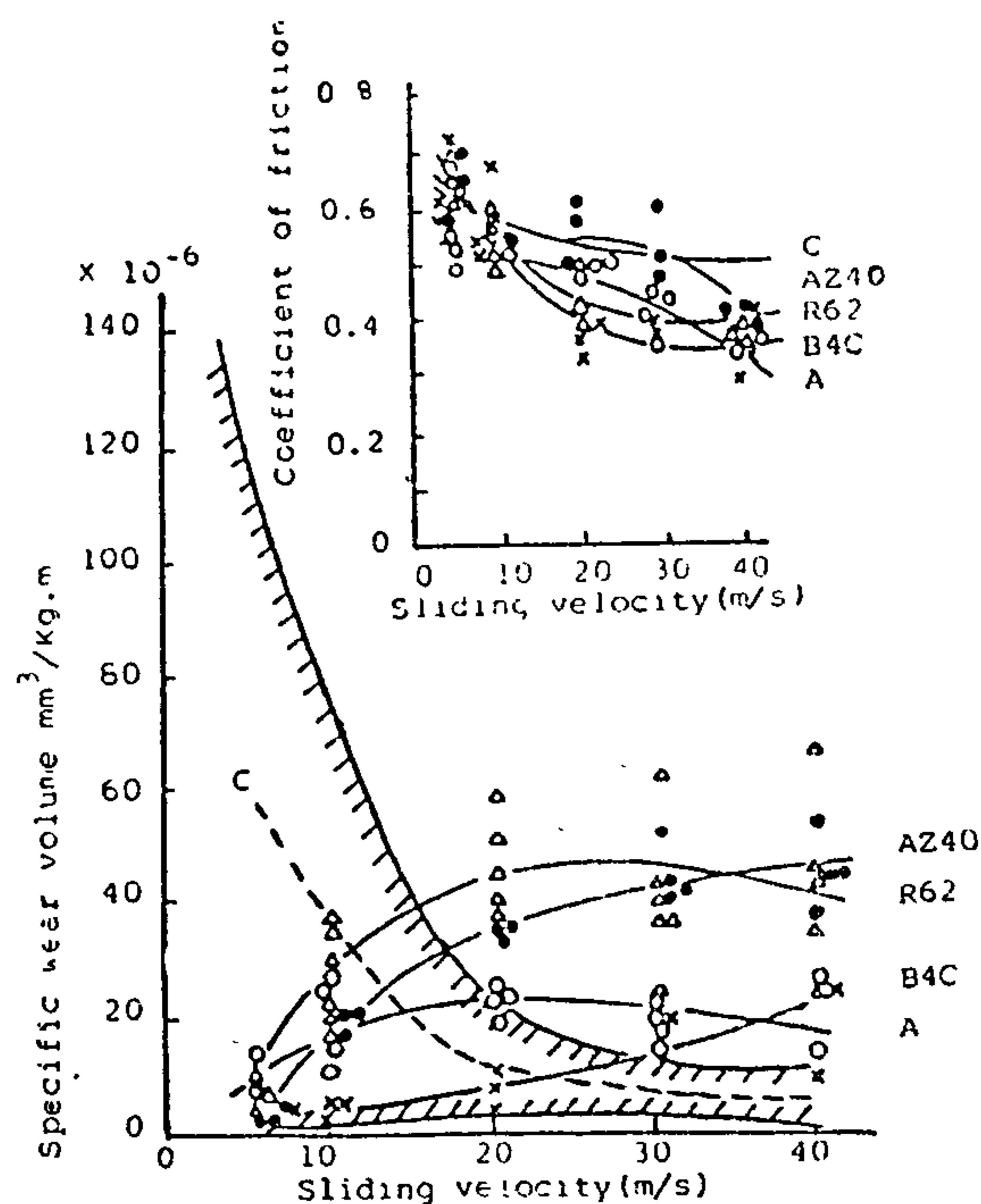
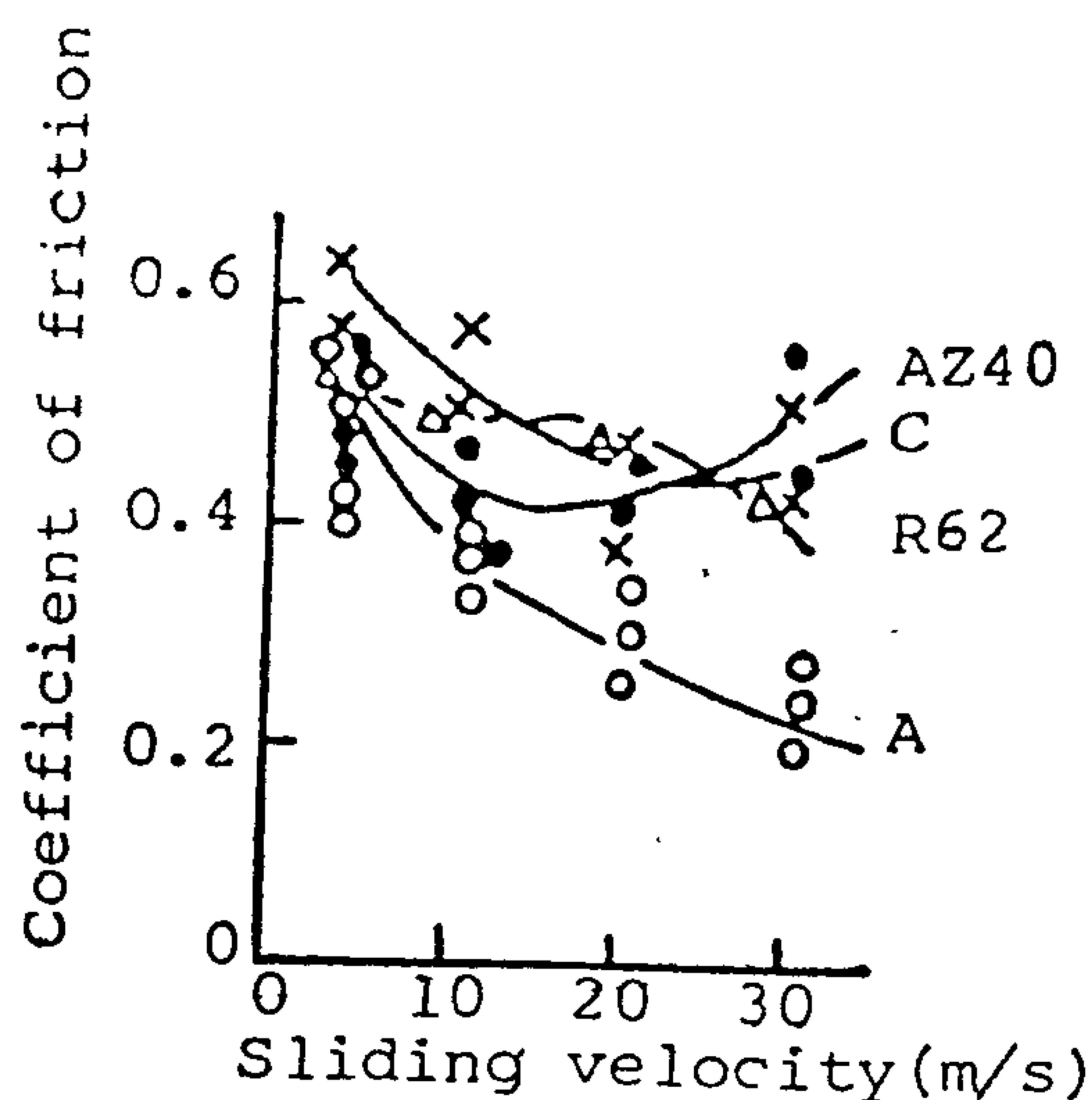


Fig. 8 Effect of sliding velocity on specific wear volume and coefficient of friction for five grain types against cast iron at a 400 gr. load.



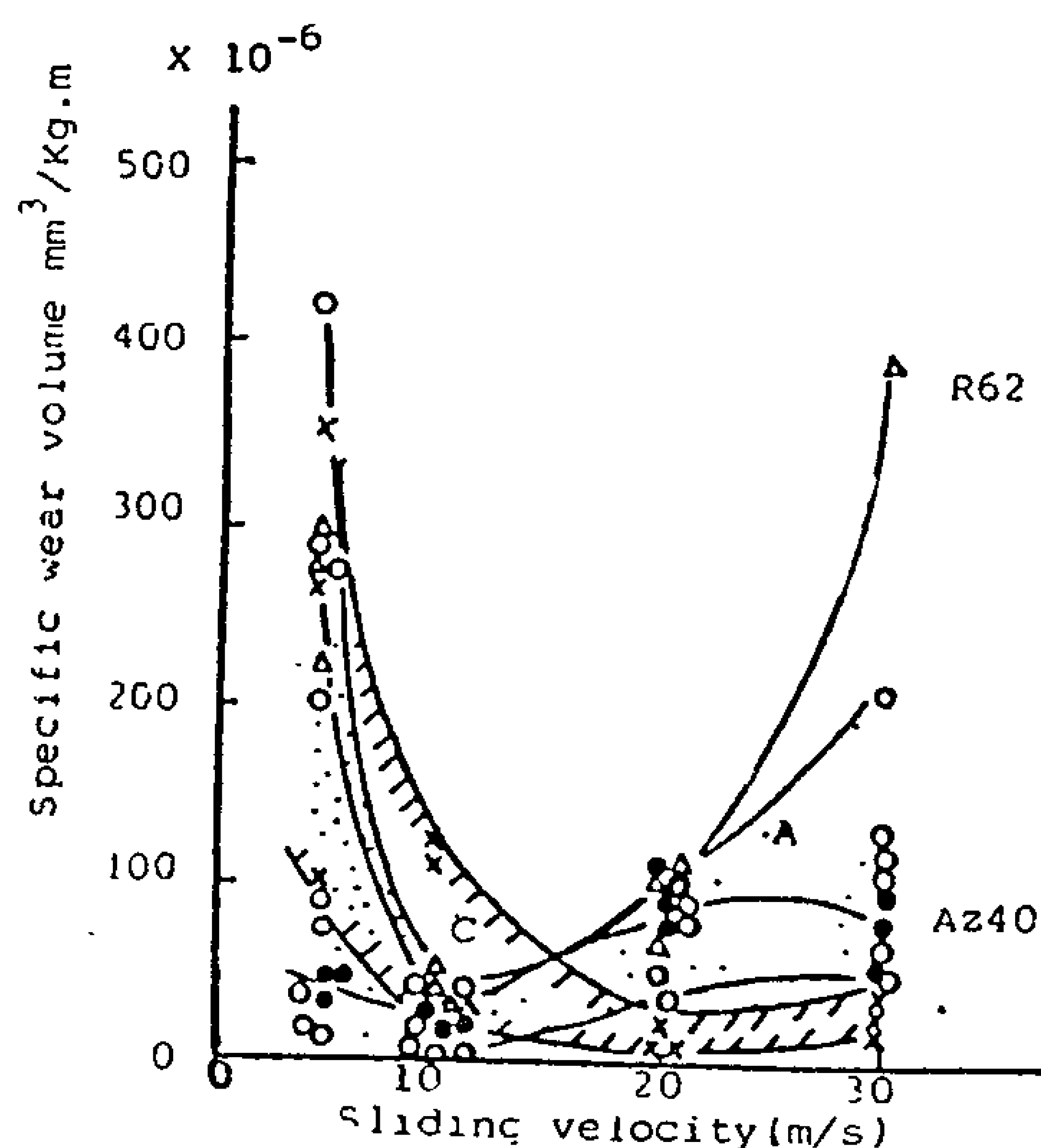


Fig. 9. Ecect of sliding velocity on specific wear volume and coefficient of friction for four grain types against stainless steel at a 400 gr. load.

Observation of the worn surface of abrasive grains

Figure 10 shows the worn surfaces of various grains sliding against the mild steel disk. To examine the adhesion and cracks on the worn surface etching by phosphoric acid was performed. There is less adhesion on the worn curfaces of grain C than of grain A. Many cracks are recognized on the worn surfaces of grain A. These cracks are considered to be caused mainly by thermal shock. Such cracking occurs more frequently as the

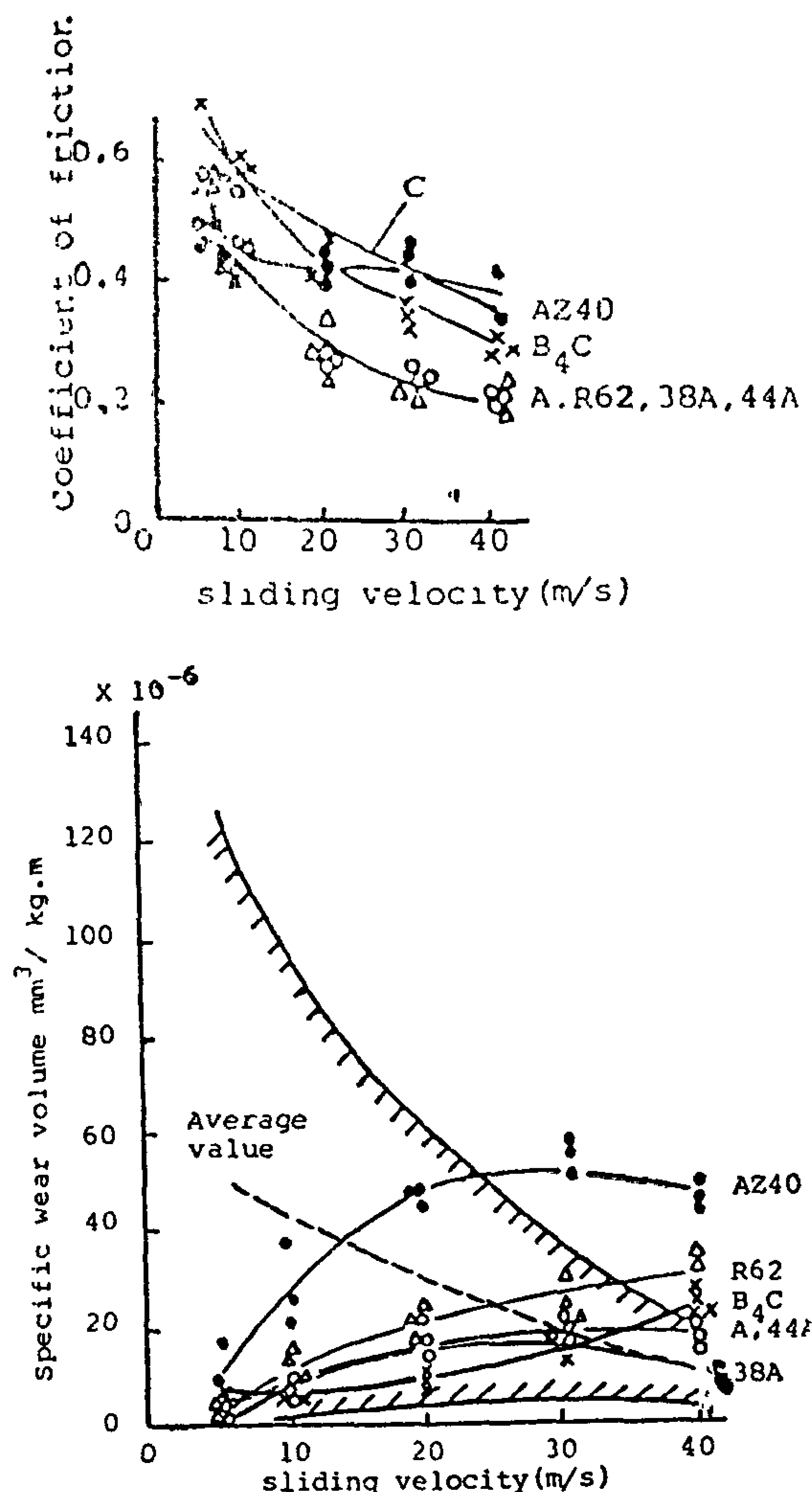


Fig. 6 Effect of sliding velocity on specific wear volume and coefficient of friction for various abrasive grains against mild steel at a 400 gr. load. Results for grain C are strongly dependent on crystal orientation (see Fig. 7). The cross hatched curves are for extreme values while the dotted curves corresponds to the mean value.

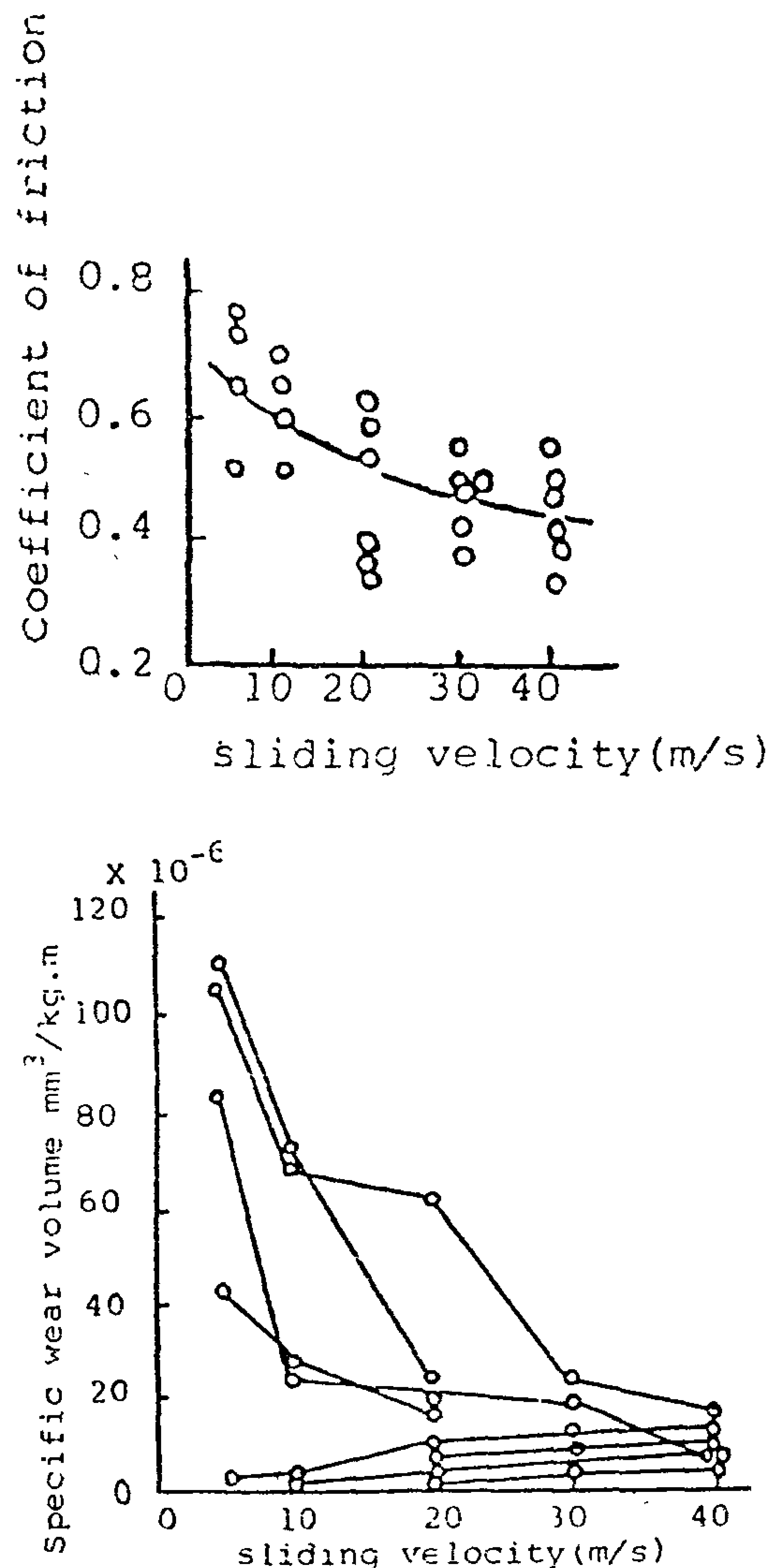


Fig.7 Effect of sliding velocity on wear volume for various crystal orientations of grain C against mild steel at a 400 gr. load.

The crystal sizes in grain C are considerably larger than those in alumina grains. Depending on sampling, wear tests may be conducted with different crystal orientation of grain C. It is well known that hardness of grain C varies with crystal orientation.

Anyhow, the K value of grain C at the lower sliding speed is the largest among the other abrasive grains, while the K value of grains AZ40 and R62 are larger than those of grains C,A,44A and 38A at the higher sliding speed. It is also found that the K value of grain C indicates wide scatter under the low sliding speed.

In general, the coefficient of friction decreases as sliding velocity increases. Grain C has the highest coefficient of friction and alumina grains have the lowest coefficient of friction to mild steel. Nevertheless, no systematic relationship exists between wear volume and coefficient of friction.

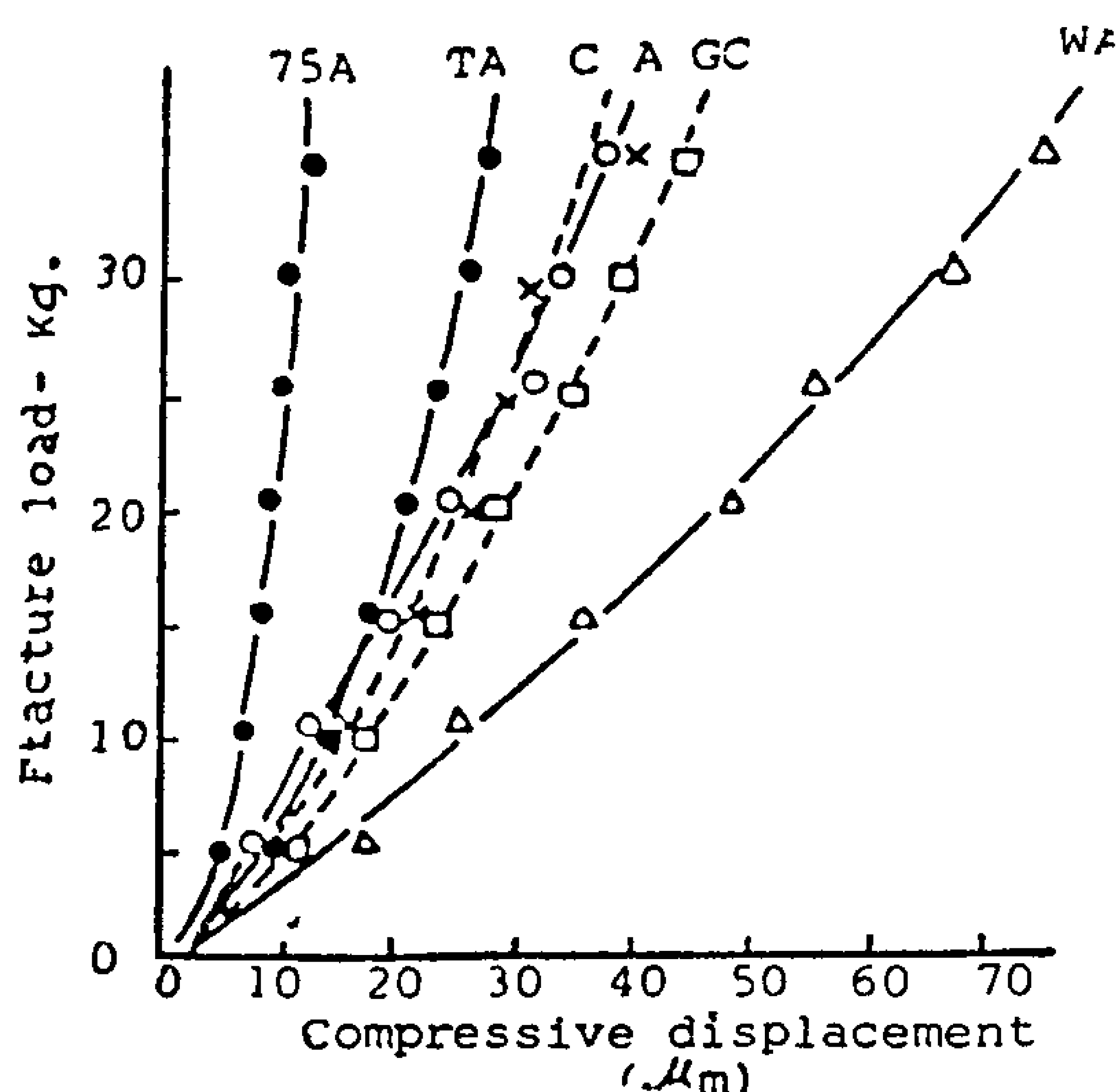


Fig. 4 Edge strength characteristics of various grains (grain size 10)

Wear Tests of Abrasive Grains

Test apparatus and procedure

The apparatus for wear tests of abrasive grain is shown in figure "5", where a single abrasive grain is pressed against the side of a rotating metal disk. Abrosive grins were shaped into cones with 120° conical angel which have a flat area of 0.5 mm in diameter at the top. The metal disks chosen were mild steel, cast iron,and stainless steel, In these experiments, the sliding was conducted on the same track at loads of 200, 1000 grams and the sliding force was measured and recorded using a strain gauge. A sliding velocity was selected which was as similar as possible to actual grinding velocity. This value was very much higher than that in experiments made by shaw and Matsuo "2".

RESULTS

It was found that the volumetric wear is proportional to load and slinding distance under any slinding velocity for all abrasive grain types tested. As a result, comparison of attrition resistance for various kinds of abrasive grains can be made by the specific wear volume K, which is defined as follows:

K = W/P.L mm³/Kg.m

where

W: wear volume mm³

P: load Kg

L: sliding distance m

Figure '6' gives relations between specific wear volume, coefficient of friction and the sliding velocity for various abrasive grains sliding over the mild steel disk, including A, 38A (white alumina), B_4C (boron carbide AZ40 (alumina-zirconia), R62 (sintered alumina) and 44A (micro-crystalline alumina).

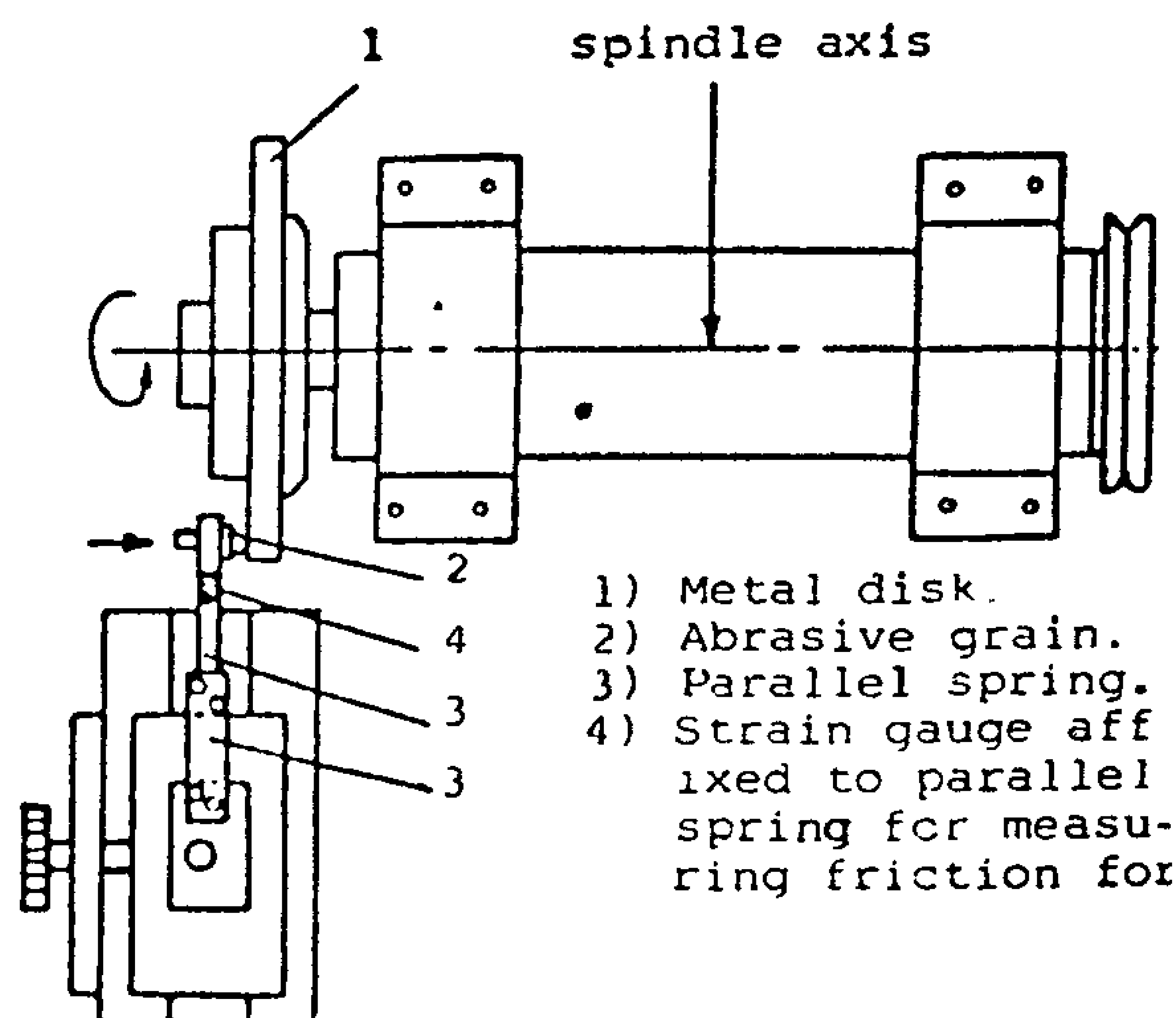


Fig. 5 A sketch of wear test apparatus.

Specific wear volume increases as sliding velocity increases, and then decreases somewhat after reaching a peak for most abrasive grains. However, such a relation is complicated in the case of grain C. As shown in figure 7, a sample which shows a high wear rate at a low sliding velocity has a decrease of specific wear volume as the sliding velocity increases, whereas a sample which shows a low specific wear volume at a low sliding velocily has an increase of specific wear volume as the sliding velocity increases. Such a phenomena may be explained by crystal orientation, as Duwell(3) pointed out in his wear test of single crystal sapphire.

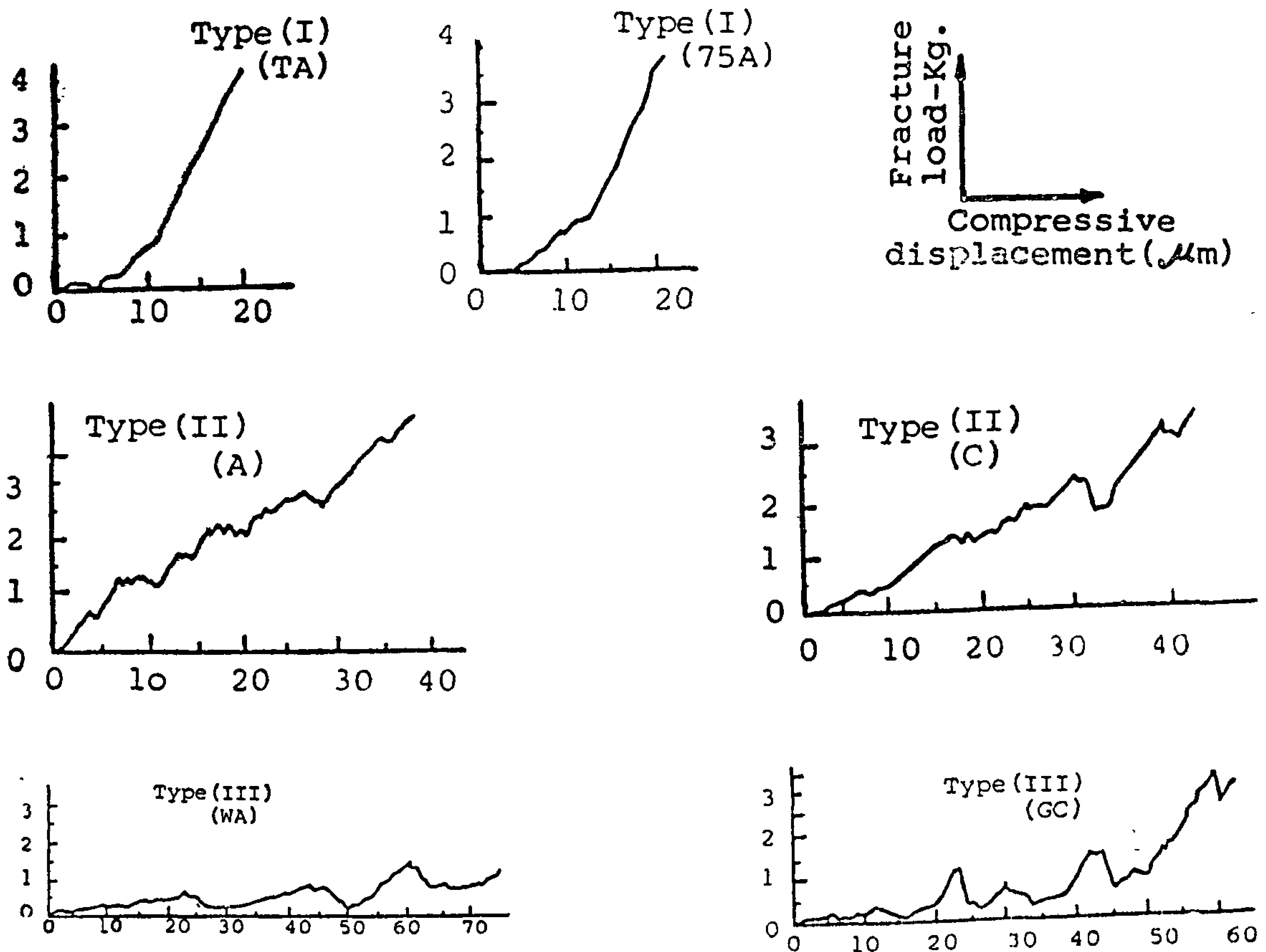


Fig. 2 Typical patterns of edge fracture characteristics of various abrasive grains (Grain size 10)

Th edge fracture characteristics of abrasive grains differ not only with the kind of grain, but also with the size of grain, as shown in fig. "3". In any case, the edge of the abrasive grain gradually changes into a shape hard to crush with the increment of compressive displacement Figure"4"shows the relationship between the fracture load and the compressive displacement of various abrasive grains which are the average of about fourty grain samples (grain size 10) respectively. Comparison of edge strength for various abrasive grains will be made this figure.. The curve with steeper slope shows higher strength. Abrasive grain 75A had the highest edge strength of the samples, followed by grains TA, A, C, GC, and WA in that order.

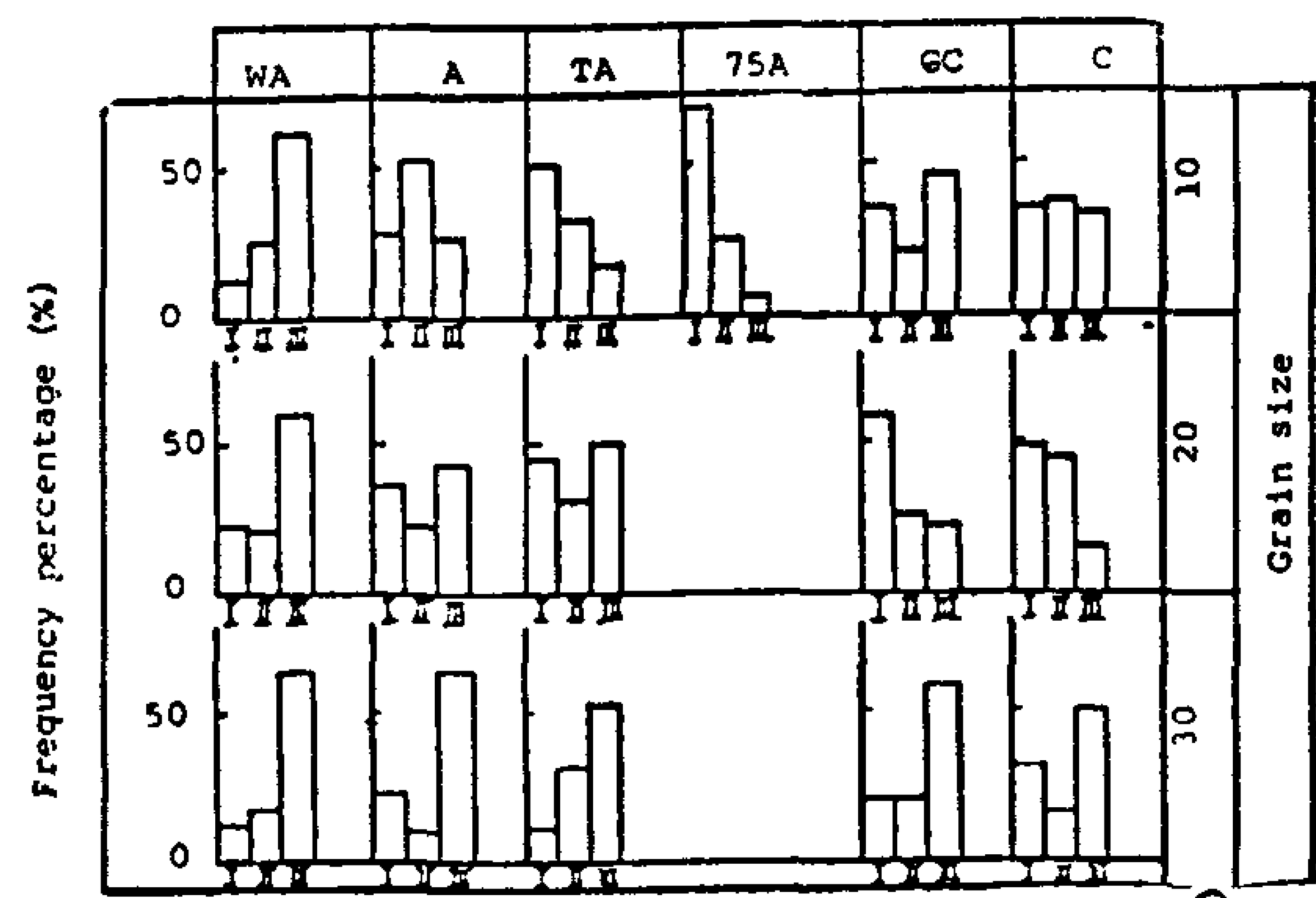


Fig. 3 Distribution of edge fracture according to size and kind of abrasive grains.

1. Generally, grains of the aluminum oxide group are stronger than those of the silicon carbide group. However, the fracture strength of grain "C" (black silicon carbide) is higher than grain "WA" (white alumina).

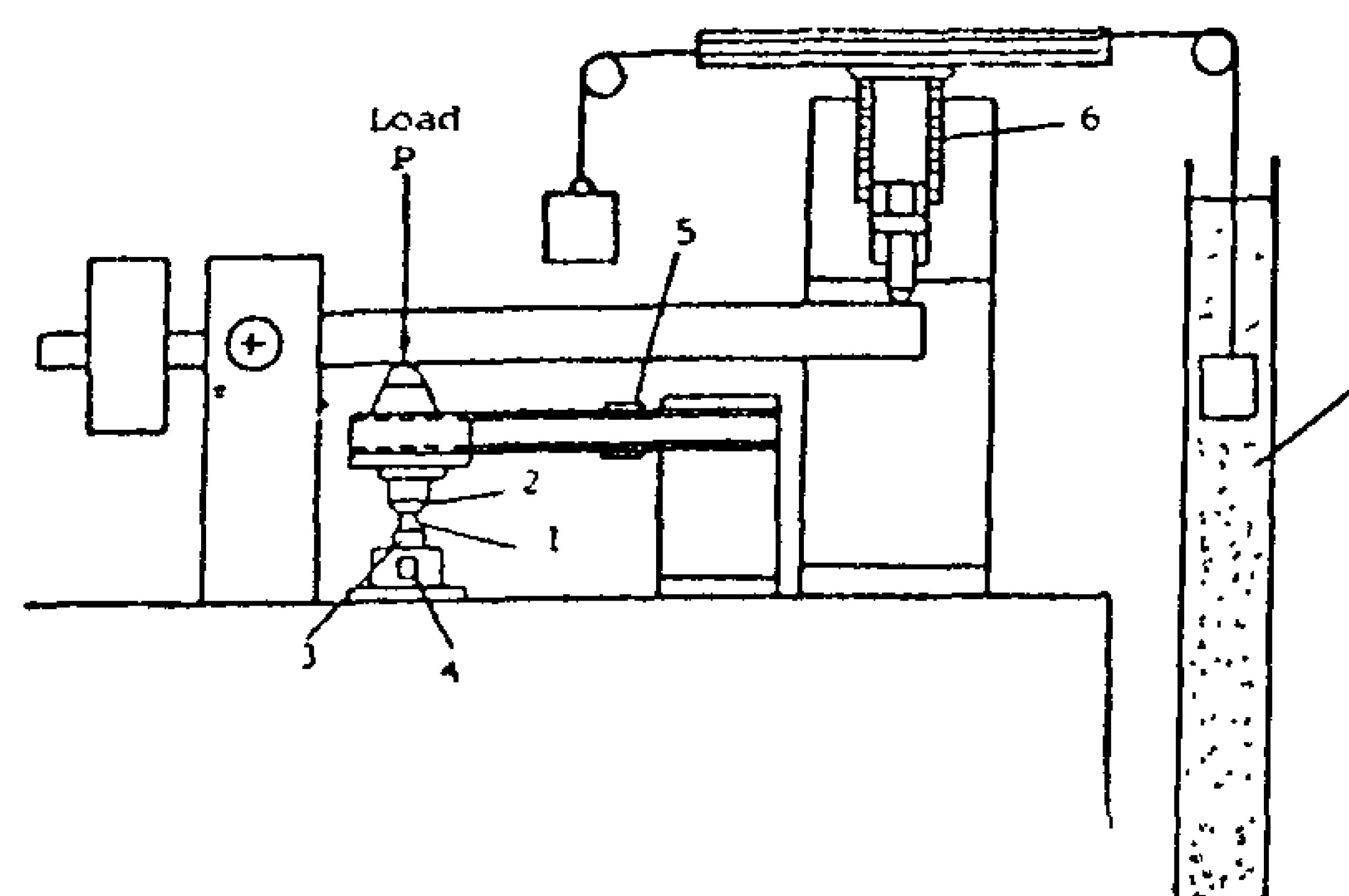
2. Variation of the measured fracture strength for the aluminum oxide group is smaller than that for the silicon carbide group. The former fractures into finer pieces than the latter. This may affect the distribution of cutting edges produced by dressing.

3. The fracture characteristics of various abrasive grains were studied in relation to their material or crystal structures. Also, it is should be noted that the fracture characteristics vary with grain size.

In the present study a new method of friability test was developed which explains the fracture characteristics of the edge of abrasive grains, corresponding to the self-sharpening action of cutting edges during grinding.

Test apparatus and procedure

Figure "1" shows the apparatus for such friability tests. The edge fracture was observed in the following manner. The abrasive sample (grain size 10) ground flat at the bottom was placed on the lower compression plate made of sintered carbide. Its upper edge was loaded by the flat portion of a diamond and therefore the edge did not penetrate into the compression plate. The fracture load and compressive displacement were measured by pen-writing oscillograph, by means of a semi-conductor gauge affixed to the cylinder under the lower compression plate and a strain gauge affixed to th parallel spring.



1. Abrasive grain.
2. Upper plate (flat surfaced diamond).
3. Lower plate.
4. Semi-conductor gauge for measuring fracture load.
5. Strain gauge for measuring compressive displacement.
6. Driving screw.
7. Oil damper.

Fig. 1. A sketch of friability test apparatus.

RESULTS

Figure "2" shows typical patterns of the edge fracture characteristics of various abrasive grains, which can be classified into I, II, and III types.

TA (micro-crystalline alumina), and 75A (sintered alumina), manufactured by Norton Co., classified as type I, were recognized as having particularly minor fracture on the edge, A (regular alumina) and C (black silicon carbide), manufactured by Norton, classified as type II had more edge fracture than type I grains. WA (white, alumina, by Norton) and GC (green silicon carbide, by Norton) show repetition of small and medium fractures with remarkable variations in the record of fracture load. This type was classified as type III, and may have close relation to the self-sharpening action of abrasive grain during grinding.

MECHANICAL PROPERTIES OF ABRASIVE GRAINS AND THEIR EFFECT ON GRINDING ACTION.

S.O. EL-HELIEBY*

ABSTRACT

It is a difficult task to select suitable abrasive grains to grind a certain material, because of the wide variety of abrasive grains available as well as the lack of a basic understanding of their mechanical properties. Most of the selection methods now in use are based on the know-how obtained from past experiences. In the precutting edges, and wear tests of various kinds of abrasive grains, especially concerning the fracture characteristics of cutt edges, and wear tests of various combinations of metal-abrasive grains were conducted. As a result, new concepts and some fundamental considerations have been achieved. That is, how the mechanical properties of abrasive grains affect grinding performance and how to select suitable grains for grinding different materials.

INTRODUCTION

Many studies have been carried out on the mechanics of grinding for long time In spite of many excellent theories which can explain complicated grinding phenomena qualitatively, it is very difficult to explain sufficiently such problems as suitable selection methods for abrasive grain and grinding wheel, grindability of work material, estimation of grinding wheel life and grinding accuracy. In this paper, results of experiments on such mechanical properties directly related to the performance of cutting edges of abrasive grains as attrition resistance and friability are discussed. Then the grinding mechanism involving self-sharpening action and the compatibility of abrasive grains with work materials are examined. It is not easy to relate these experimental results to practical grinding phenomena, because wear and friability tests of abrasive grains performed here are simplified model tests and,further the roles of bonding materials in grinding wheels during grinding are not explained clearly as yet. Wear tests were performed with continuous sliding on the same track and result in attrition resistance as a physical nature of abrasive grains. The friability tests were performed with a static mechanical load exclusive of thermal load. The cutting edges of abrasive grains on a grinding wheel, as first produced by dressing, undergo complicated changes with the progress of grinding, such as wear and fracture of abrasive grains, due to ever-changing mechanical and thermal loads. Thus, although these tests are rather simplified, it seems that data obtained are quite useful in explaining some of the problems mentioned above.

EXPERIMENTAL WORK

Friability Tests of Abrasive Grains

In previous friability tests of abrasive grains, a single abrasive grain located between a pair of parallel plates of sintered carbides was crushed by a gradually increasing load and the following conclusions were obtained (1);

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NOMENCIATURE

a	Depth of cut, [mm]
C,x,Y,z,C_I,n	Constants for a given cutting tool-workpiece materials, eqs. (1,2)
C.C.-T	Cemented carbide tip tool.
C_t -T	Cutting temperature-Tool life equation.
f	Flank wear, [mm]
H.S.S.-T	High-speed steel tool.
Q	Average cutting temperature, [C°].
s	Feed rate, [mm/rev].
v	Cutting speed, [m/min]
T	Tool life, [min].
t	Cutting time, [min]

The increase of the cutting conditions (v, s,a) will increase the cutting temperatuer (Q), the tool wear, the constant(C1) and the exponent (n).

If the tool life is 1 min., the cutting temperature (Q)will equal the constant C1.

The optimization condition that ensures best operation may be summarized as follows;

1. Maximum rate of chip volume, i. e., (vxsxa);
2. Minimum value of tool wear, i.e. maximum tool life;
3. Minimum value of cutting temperature, (i.e. (large value of the exponent, n and small value of the constant,C $_1$ tools.

Table 3 presents the most suitable operating conditions, which should be used for the tools considered in the present study.

Table 3 : Best operation conditions

Cutting Tools	Cutting Conditions Speed v m/min	Feed s mm/rev	Depth a mm	Tool Wear f mm	C_t-T_1 Equation $Q\ T^{1/n} = C_1$
H.S.S.	55	0.12-0.42	1.2	< 0.7	$QT^{1/19.0}=484$
C.C.	55	0.12-0.42	1.2	< 0.4	$QT^{1/7.91}=512$

CONCLUSION

From the present work it can be concluded that;

1. The optimum cutting tool temperature was found to occur at the following cutting variables :

a) Cutting speed used were :

i. For high-speed tools from 10 to 20m/min.

ii. For cementrated carbide tools from 35 to 50 m/min.

b) The depth of cut, ranged from 0.3 to 1.2 min for high-speed steel and carbide tools.

c) Feed rate, varied between 0.12 to 0.42 mm/rev for high-speed steel and carbide tools.

2. Effect of the feed rate is the smallest on the cutting tool temperature compared with the effects of cutting speed and depth of cut.

3. The use of cemnnted carbide tool produces the minimum amount of tool wear.

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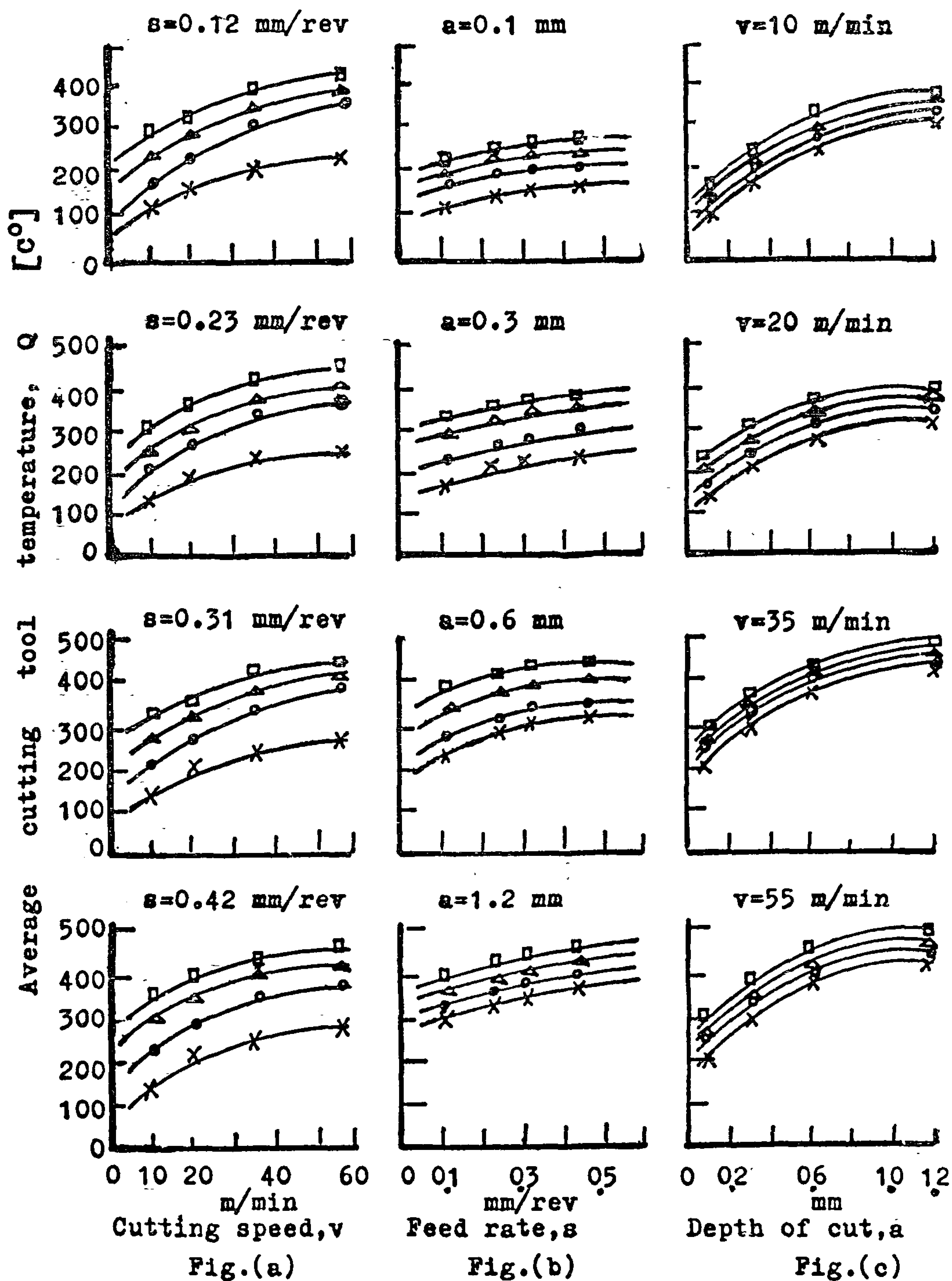
b) Cutting temperature-tool life equation

Table 2 shows the equation driven from the present study to evaluate th eaverage cutting temperature as function of the tool life. An equation is presented for each tool at different cuting conditions up to flank wear value and cutting time used. The exponent n of eq. 2 is evaluated from the figures shown in Table 2.

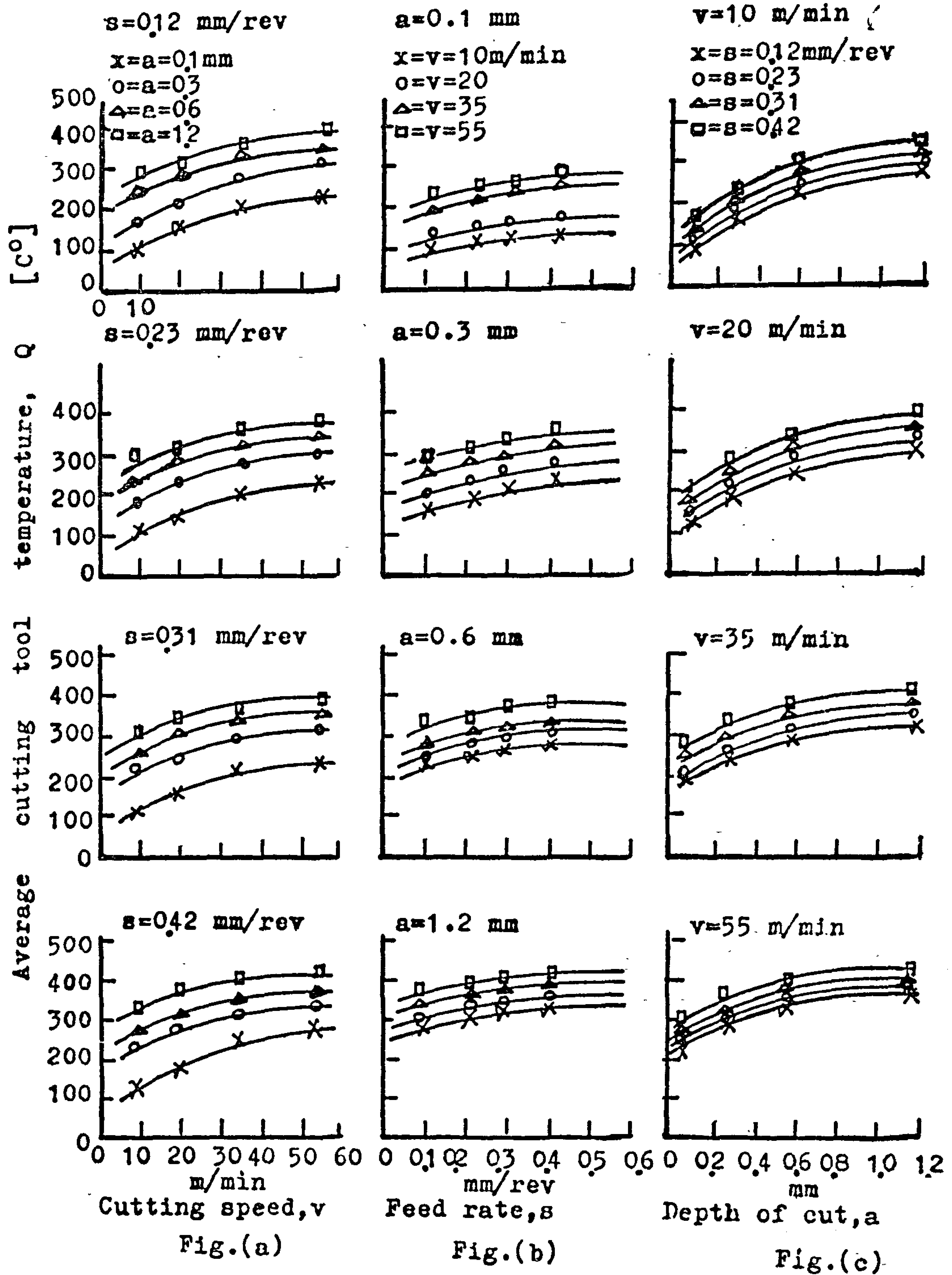
Table 2 : Temperatural-Tool Life Equations

Tool Life Criterion Flank Wear mm	Cutting Condition Feed s mm/O	Depth a mm	Speed v m/min	Cutting Time t min	Q_T - Diagram Cutting Temperatures / Tool Life	Equation $Q\,T^{1/n}=C$ HSS.T	CC.T
Up to	0.12			59.26	Average Cutting Tool Temperatures, Q,C°: 630, 400, 250, 160; Tool-Life, T,min: 10, 16, 25, 40, 63; HSS.T △, CC.T ○	$QT^{1/631} = 360$ (3)	$QT^{1/4.70} = 395$ (4)
0.2	0.31	0.3	10	22.90			
0.1	0.42			16.93			
Up to	0.12			14.81	630, 400, 260, 160; Tool-Life, T,min: 4.0, 6.3, 10, 16, 25	$QT^{1/4.62} = 524$ (5)	$QT^{1/3.73} = 535$ (6)
0.4△	0.31	0.3	35	5.73			
0.2°	0.42			4.23			
Up to	0.12			10.66	630, 400, 260, 160; Tool-Life, T,min: 2.5, 4.0, 6.3, 10, 16	$QT^{1/16.35} = 410$ (7)	$QT^{1/7.11} = 418$ (8)
0.5△	0.31	0.3	55	4.13			
0.3°	0.42			3.04			
Up to	0.12			59.26	Average Cutting Tool Temperatures, Q, C°: 630, 400, 260, 160; Tool-Life, T,min: 10, 16, 25, 40, 63	$QT^{1/7.11} = 579$ (9)	$QT^{1/5.05} = 617$ (10)
0.5△	0.31	1.2	10	22.90			
0.2°	0.42			16.93			
Up to	0.12			14.81	630, 400, 260, 160; Tool-Life, T,min: 4.0, 6.3, 10, 16, 25	$QT^{1/11.43} = 481$ (11)	$QT^{1/6.31} = 490$ (12)
0.5△	0.31	1.2	35	5.70			
0.3°	0.42			4.23			
Up to	0.12			10.66	630, 400, 260, 160; Tool-Life, T,min: 2.5, 4.0, 6.3, 10, 16	$QT^{1/19.0} = 434$ (13)	$QT^{1/7.91} = 512$ (14)
0.7△	0.31	1.2	55	4.13			
0.4°	0.42			3.04			

HSS.T = △ & CC.T = ○



Figs. 5 Effects of cutting speed, feed rate and depth of cut on average cutting tool temperature.



Figs. 4 Effect of cutting speed, feed rate and depth of cut on average cutting tool temperature.

3. Tool Temperature Relationship

a) General equation

Ultilizing the solving systems of linear equation using the Gaussian Method [10], the functional relationship between cutting-tool temperature (Q) and different cutting conditions (v,a,s) is given by :

$$Q = C\ v^{x} s^{y} a^{z} \qquad (1)$$

Where : C,x,y and z are constants for a given cutting tool-workpiece materials.

b) Temperature-tool life relation

Relationships between tool life and cutting speeds have been measured for many years. This work is made difficult by the fact that seperate determinations have to be made for each tool and workpiece combination that is of interest. Cutting tool temperature measurement offers not only a more rational approach to tcol life, but also it can save a great deal of time in rating machinability of material cutting tools.

The series of experiments designed to relate tool life (T) and cutting tool temperature (Q) is defined, as:

$$Q\ T^{1/n} = C_{1} \qquad (2)$$

where : C_1 and n are constarts for a given cutting-tool-work materials.

RESULTS AND DISCUSSION

Experimental runs may be viewed to correspond to a 4^3 design for two applied tool-materials. This means that 3 factors : v, s & a are applied, each with 4 levels. Accordingly, the number of ex-

$4^3 \times 2 = 128.$

periments should be equal :

Figures 4 and 5 represent plots of the relation between the average cutting temperature and the different cutting conditions at two cutting tool materials. It can easily be seen that the average cutting temperature increases by an approximate paralled and smooth curves hwen the cutting speed, feed and depth of cut increase. Since we have three variables (v,s,a) and each variable has four conditions, each sub-figure of Figs. 4,5 contains four curves, each curve represent the variations of two variables but the third variable was kept constant. Figure 4 represents the variation of average cutting temperature with the three variables for H.S.S. -tool, while Fig. 5 shows the variations for C.C.-tool.

Table 1 represent the effect of cutting conditions on the percentage increase of cutting tool temperature for both tools used. Generally speaking the percentage increase for H.S.S.-tool is higher than that for C.C.-tool. The average percentage increase of temperature for H.S.S.-tool is about 12% compared with that for C.C. -tool.

Table 1 represent the effect of cutting the increasing percentage of cutting tool temperature.

Variable factor	Increasing% of the cutting tool temperature H.S.S.-tool.	C.C.-tool
Depth of cut, a [mm]:		
3 time (0.1 to 0.3)	34 %	30 %
4 time (0.3 to 1.2)	35 %	25 %
6 time (0.1 to 0.6)	42 %	40 %
Feed rate, s [mm/rev]:		
2 time (0.12 to 0.23)	4 %	3 %
3 time (0.12 to 0.31)	9 %	9 %
4 time (0.12 to 0.42)	13 %	11 %
Cutting speed, v [m/min]:		
1.5 time (35 to 55)	7 %	4 %
2.0 time (10 to 20)	17 %	13 %
3.5 time (10 to 35)	33 %	26 %
5.5 time (10 to 55)	37 %	34 %

Cutting-Temperature-Relations

a) General equation

To evaluate the constants of eq. (1), the Gaussian method mentioned in Ref. [10] was used to obtain an equation representing each specified tool in the present study. The following equations are obtained :

i — For High-speed steel tools:

$$Q = 409\ v^{0.273} s^{0.563} a^{0.428} \qquad (1,a)$$

ii- For Cenmented Carbide tools :

$$Q = 179\ v^{0.259} s^{0.137} a^{0.280} \qquad (1,b)$$

Note that the following dimentions are used to specify the above equations Q in C°, v in m/min, s in mm/ rev and a in mm

EXPERIMENTAL PROCEDURE

1. Experimental Set Up

Experimental tests were carried out on a centre lathe type (MARTIN KM 230). The workpiece material was low carbon steel (DIN C15) with (o.14% C, 0.25% Si, 0.45% Mn, 0.04% P and 0.05% S). Its ultimate tensile strength is 500 N/mm. Rods 400 mm long x 70 mm diameter were prepared with longitudnal turning to one cut length/cutting variables. The cutting tools were cemented carbide tips of grade P25 and high-speed steel type (18-4-1). Both cutting tools had a rake angles of 12° and clearance angles of 5°. All tests were carried out dry. Cutting-edges were frequently examined. Values of the length of flank wear at which the tool-life is said to be over [8] are 0.8 and 1.5 mm for tools carbide and high-speed steel tools.

2. Tool Temperature Measurement

A wide variety of methods mentioned in Ref. [9] have been used to estimate the chip-tool interface temperature, including complicated radiation pyrometers, embedded thermocouples, temperature sensitive paints, the development of temper colors, and indirect calorimeteric techniques, all of these methods suffer from slow speed of response, adverse geometric considerations or the indirectness of the measurement. The most successful approach to this problem is the tool-chip thermocouple, while the tool-chip contact area serves as the hot junction in a ther-thermo-electric circuit and the emf generated is proportional to its temperature, sec Fig. 1. The tool-chip termocouple method is used in the present study to estimate the chip-tool interface temperature.

The simplest and possibly the most accurate method for calibrating the tool-chip thermocouple is scown in Fig. 2. Its temperature is measured with a standard chromle-alumel couple, two typical calibration curves are shown in Fig. 3.

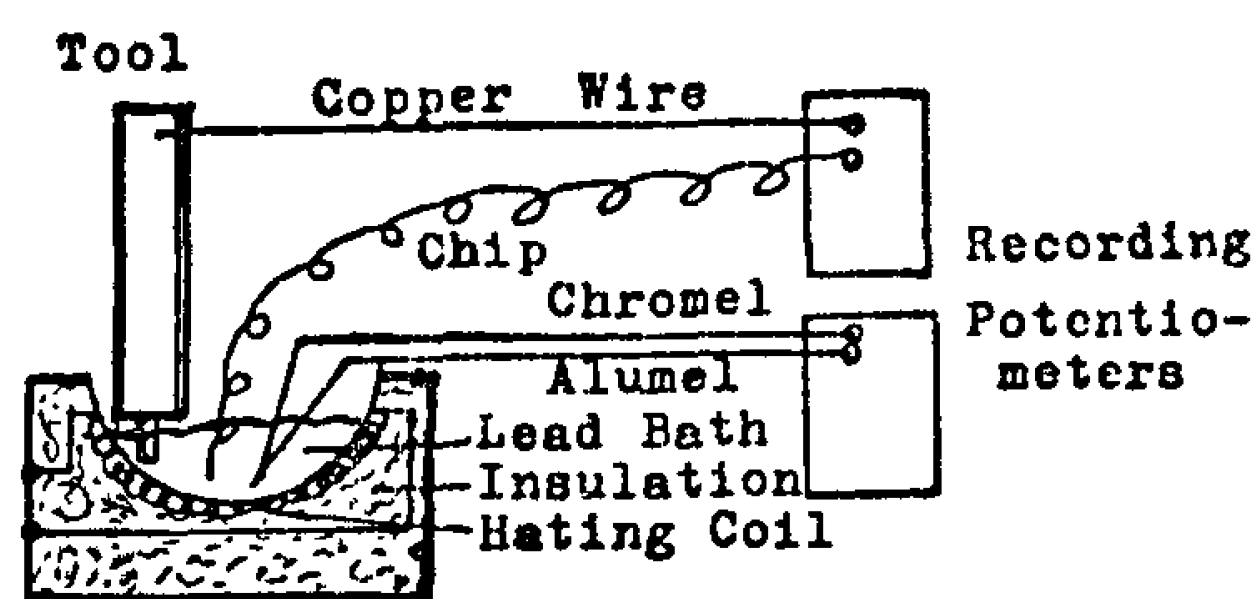


Fig. 1 Tool-Work thermocouple arrangement on a lathe.

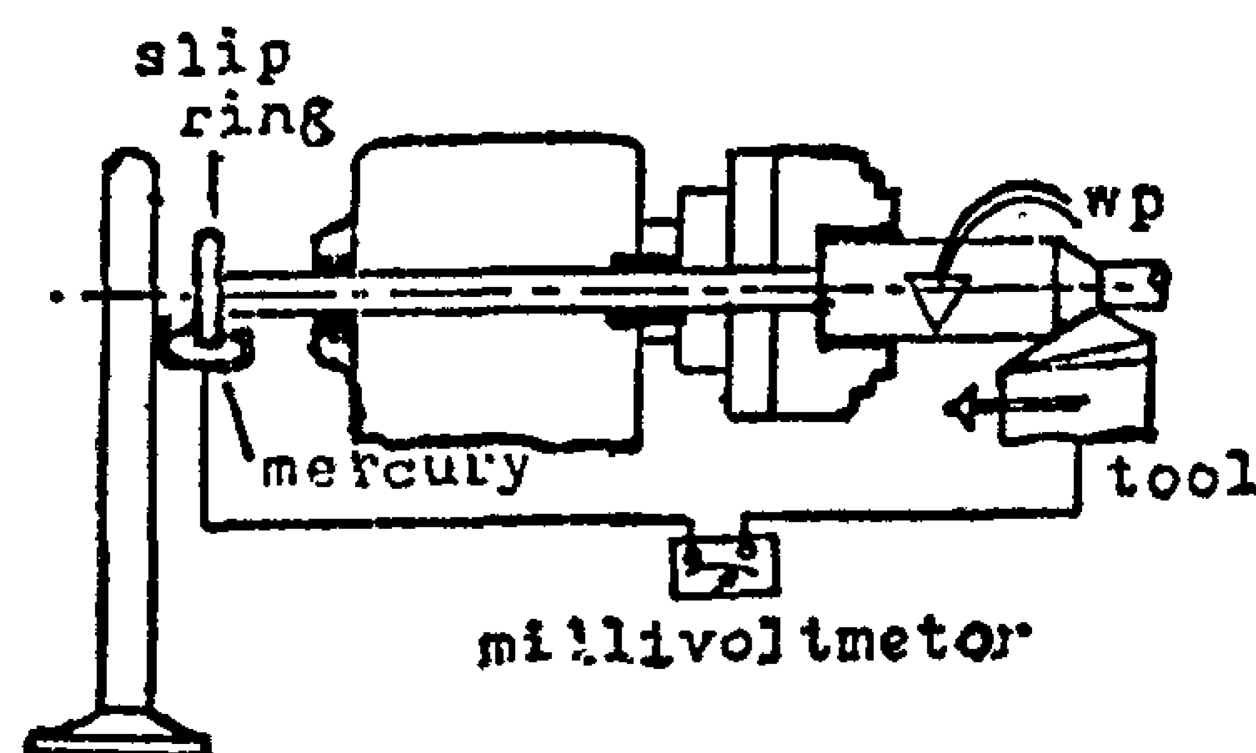


Fig. 2. Arrangement for Calibration of Tool-Work thermocouple.

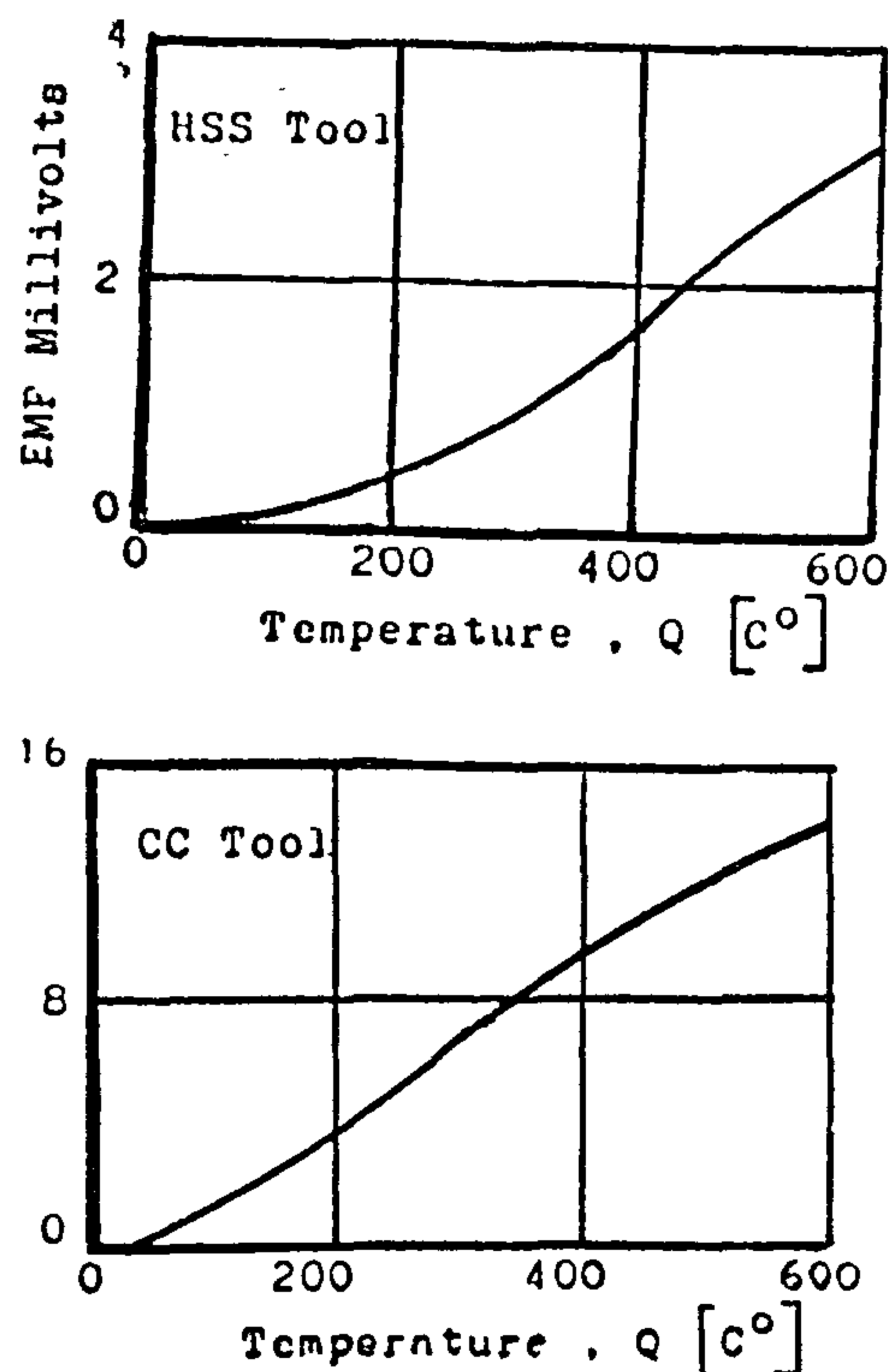


Fig. 3 Temperature Calibration Curves.

CUTTING TOOL TEMPERATURE

I.M.I. MOBAREK*

ABSTRACT

The generated temperatures during metal cutring have a controlling influflence on the rate of the cutting tool, hence on the tool life and the surface finish. Because of these reasons, the cutting temperatures are considered as a very important subject to deal with in the field of metal cutting.

The various factors which lead to increase cutting tool temperature are cutting speed, feed, depth of cut, and cutfield of metal cutting.

It was found that the cutting speed, cutting depth, and cutting tool material have major effect on the cutting temperatures. The maximum temperature generated, in the present study did not lead to the failure of cutting tool. However, if the generated temperature is high enough, failure of the cutting tool will occur.

The present study made a comparison between the behaviours of two cutting tools (high-speed steel and cemented carbide tips). These results are presented in tables.

INTRODUCTION

In operation, a machine tool behaves like an inverse heat engine, i.e., in machine tool mechanical energy is supplied whereas heat energy is produced during metal cutting. This heat energy is generated in two main areas[1] : the first is the area of shear, where heating is caused by deformation of the metal, while the second area of heat is produced by friction where the chips rub across the tool top-face. The temperature here is determined by the area of contact and the frictional behavior of the work and cutting tool. Higher cutting speeds cause a temperature rise in both areas, but temperature in the tool-chip interface area has the greatest effect on tool life.

A large number of research workers have investigated various aspects of heat generation in metal cutting. These researches were also partially motivated by the researches in tool wear processes which are highly temperature dependent. Infra-red photographic technique has been employed by Boothroyd [2] and Friedman and Lenz [3] in metal cutting to determine the distribution of temperature in tool, chip and the workpiece material near the cutting zone. Chao, Li and Trigger [4] studied the temperature distribution on tool-chip contact length.

Several theoretical analysis of the cutting temperatures in the workpieces and shear zone have been carried out, two of the more successful being those of Weiner[5].

Using the thermocouple technique, the temperatures at selected points around the end face of the tubular workpiece were measured [7]. and then used to calculate the proportion of the shear-zone heat conducted into the workpiece.

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network component is copied to the th-frame for the solution. The last action is by the rule stored in the th-frame The layer model may simply contain an interpretation to the contents of the nodes if any symbolism is used. This fact is true to all other techniques however if node contents are expected to be complete this could be done without. Finally the specializer is as all previous cases. Notice that in all cases the proof handling of matching has been used.

In a general ND-context one may form the wf-frame network component as node p semantically linked to node i and in turn semantically linked to node f. Also node T semantically linked to node a and this in turn semantically linked to node f. Then all nodes P to f and f to t linked sequentially. The rules to four if p d then i, if tc then a, if iI then f, if aI then f. The operators to be matching, sequential techniques, trial and error search. The th-frame network to be the failure state goal node. The rule component to be the condition pd match. The solution goes through the pd match indicating start by rules and generate network part structure for pd so the semantic link to node i is formed in a temporary work wf-frame after adding the corresponding rule to it in the rule component. The goal node is checked to be nonexisting yet. The temporary network is compared for matching structure with the network of the wf-frame, then once found it is advanced through semantic links only, if not found then failure is reported. Advancing and adding to the temporary area until the goal node is found. The resulting structure is copied to the th-frame as a procedure solution along with the rule as a hint to the strating situation.The layer general is again the same, the model contains interpretation for all symbolism such as p pressure d decrease, integrety, I for so on. The specializer again is the same previous.

Notice the power of this general formulation in using an almost network like formulation for the network component along with the production like rules making use in the initialization, this will also be useful in finding alternatives by using different intializations. The operators are a mixture from different techniques of problem solutions and knowledge handling allowing the handling of all types of knowledge. The layer model is quite simple like that of the logic. The th-frame is also simple and comparable to logic techniques in finding the one situation that fits besides the simplicity of the solution deduction instead of the tautoloy procedure. The advancements are at the small cost of the extra temporary work area wf-frame. A final comment, is the interrupt handling ability. If such a rule be asked for in the given example, the evaluation will simply imply the given th-frame of the proof rule handling; however when a solution is found, the layer is called so that the general be used to access that part related to the solution. More important, this allows the user to interact and add information dependent upon the solution in which case more of the general be displayed.

In conclusion, the technique is reliable in the sence that it easily accomodates to all types of knowledge : objects, events, performance or metra knowledge. It is general in the sence that it may incoorporate the different types of knowledge representation techniques as has been exhibited by the example. More important it gives provision to including any future specialized techniques. It is intelligent by all criterions of extendability, simplicity, consistence, completeness of syntax as well as semantics, inclusion of default knowledge and still allowing for the undeterministic interaction.

pressure, and temperature, integrity, adequateness and failure. There will be links for decrease and increase from pressure to integrity and adequateness respectively which in turn have links to failure. There will also be non-semantic links just sort of going from one node to another in order to form all the nodes as one list, helpful for traversal in order to find initial conditions. The rule components will be matching of structures, and the operator will be follow the links, where the link points in one particular direction. (If a second direction is required a second link is used between the same nodes. The th-frame network will contain condition node decrease pressure linked to the goal node failure. The rule is find a root from condition to goal. This is a slight modification to the technique that matches structures directly. Here the matching is the initial and final with any intermediate structure to be possibly placed. In matching, links are traversed until the third node is found to match the condition now the semantic links are followed using the direction until either a dead end is found no possible route untraversed is found or the goal node is found. Here the solution is clear through the questioning of the integrety of the pressure control. The layer general is the same as in previous case, as a matter of fact it will be the same for all representations. the model is an interpretation for the links from pressure is decrease, the temperature is increase from the integrety is false to indicate doubting as well as from the adequateness to indicate not adequate. This means that semantic links have labels (in this case we need three labels for the four links) and the last link true indicating the occurence of the failure. The specializer again may be for some serious situation.

For the frames the wf-frame network component will be the reactor accident node with links for the slots say rules that joins two nodes for pressure and temperature. The rules and operators are again like the network. In some cases more operators may be required for special nodes linked to slots. The th-frame will contain one node of the condition with the slot question accident state. Again for the layer the general is the same the model needs interpretation for all the symbols used with slots so that the first slot symbol of rules indicates all possible rules of increase pressure, and decrease temperature. Notice here the semantics is slightly more difficult for the interpretter has to see the contents of the node linked with the slot. The specializer is again the same.

For the production-rule representation, the wf-frame network component again will be one node representing the blackboard or short term memory, the rules are the normal rules and the operators are different techniques for applying the rules. The handling or rules will be of the proof type. Again the layers of semantics will interpret context information.

In solution to the example the wf-frame network component starts empty. The rules contain the four conditions of pressure decrease, temperature increase, doubting integrety, and inadequate to indicate failure. The operators may be many to form any type of production-rule system for simplicity assume we take one form of choosing rules sequentially. The th-frame network will contain the condition node linked to the goal question. The rule will be new rule deduction. The operator is empty by definition. Now the operation starts by Filling the wf-frame from the first node of the th-frame, looking at the rules sequentially the first applies and a node is linked with the action of doubting integrety. This node is again chosen and sequentially the first rule does not apply and the third applies to give the failure node which matches the th-frame in which case the process ends and the

Applying for the example : We may have the following wffs ;
For the rules ∀x [D(x) == > ~I(x)]
Vy [C(y) == > ∃z ~A(z)]; ∀x∀z [~I (x) v ~A(z) == > ∃s F(s) ;
For the existing condition]x D(x) ; hence a]s F(s); the set of rules along with the condition in clause form is (~D(x) v ~I(x), ~C(y) v ~A (g(y); I(x) v F (h(x, z)); A(z) v F (h(x, z)), D(a)) In the ND-notation (the wf-frame will be as follows :

the net work component will have five nodes one for each clause and a pointer from each to the next, in order to access each clause. The rule will be the resolution principle and genrated the empty clause. The operators will be two one for the unification process, the other for the generation of resolvents. (several more operators may be added to choose a search technique such as the ancestory -filter.) There will necessarrily be a th-frame where the clause for the negation of the question will form the network component of the th-frame (one node for 'F(s)). The rule component will be use tautology to get an answer (to indicate the accident occured due to which condition state) and the operator component is nil. The layer will contain the following : the general will contain possible information about reactors such as levels of pressure control and temperature in our case. The model will give specific interpretations to the symbolism : D for decrease x for the pressure, I for integrety, C for increase y for the temperature, A for adequate and z for heat transfer F for failure indicating accident and s status. the f is a relation between the temperature and the heat transfer, and g is the relation between the status and each of the pressure and heat transfer. The specializer in that example may exist to have special information about nuclear failure due to its seriousness. The proof will handle the wf-frame using the resolution principle until the nul clause is generated with the help of the th-frame. The th-frame is updated by the addition of any clause that is unililiteral so that whenever a uniliteral is generated in the wf-frame it is compared for matching with th-frame for the existance of its negation. In this case taking the nodes in order with a unit preference for example then nodes one and five start to give I(a) to be added as node six to the wf-frame and is also added to the th-frame,, then used with node three (nodes to be always considered from the beginning to get F(h(a,z)) to be matched with the th-frame and no need to add it. Now it is added for the tautology to get F(h(a,z)) to be interpretted by the layer the relation of the state is due to a special pressure value a (having considered other elements such as the heat transfer z not a reason of failure in this case). Oviously the result is true from the given condition.

For the semantic networks, the wf-frame network component is clearly the network, the rules is simply one matching and the operator is the procedures for graph traversal. Again the handling is by the proof rule with consideration that it is an answer question type. The frames representation is of course similar to the semantic network approach. The wf-frame network component is simply one node representing the frame, the rules are simly matching again and the operators are the necessary slot procedures. The handling is again the answer type of proof handling. The layers of semantics, will have a unified interpretation for the nodes.

Solving the example the wf-frame network component will be nodes for

The implementation of the technique is a menu driven helper where each of the wf-frames, to be generated be represented by a knowledge file, typically a direct access file of variable records and each of the layers to be generated represented by another knowledge file which need not be of direct access, as a matter of fact with the computer capabilities today it is suggested that they be sequential record files stored on some external media due to the large size they are expected to be of. These flies may be compared to the amount of knowledge stored in the brain of an old wise human being. Some of these layers are to be accessed as domain calls for. The manipulation of this helper knowledge system would be through the ND symbolism specifying the necessary files to be handled along with the fields of action. The main advantage of creating such a helper system is that with a few interfacers added the system may be able to use the existing knowledge handlers that use other knowledge representation techniques. In other words, the logic interface will necessarily take clauses from any automatic theorem prover and create the necessary wf-frames and th-frames ready to be automatically proved by an expert system built using the ND-technique.

4. Evaluation and Conclusion.

The main contribution of this work is the presentation of the concept of a generalized KR technique. It is noted that the technique is based upon five variables. The choice coincides with the fact that normally humans use five senses in gathering knowledge to be acquired, retrieved and reasoned with in the brain. Audio-visual sensing is to be expressed through the variables x in the wf-frames and i indicating the handling. Odour and taste are believed to be included through the varibles y in the layers and z for semantics. Finally texture information is imagined through the complexity variable J. More important, it should be clarified how existing techniques may be incoorporated as special cases of the proposed technique. This will be illustrated by example. It is obvious that certain examples may be directly solved as they are in existing systems if we directly show that other techniques may be incoorporated as special cases of the generalized proposed one. Nevertheless, an example has been chosen to illustrate the forulation involved.

Example. A reactor accident is reported under several conditions one of which is doubting the integrety of the pressure control system if the pressure control decreases. The second situation is a report of an inadequate secondary cooling system heat transfer when the control system temperature increases. It will be necessary for the expert to report the occurrence of the accident when the pressure control decreases.

[This example is a part of the example used in [6] copyright from Intellicorp, to illustrate the frame technique. It will here be used to illustrate how the frame-technique be incoorporated in the ND-technique as well as a reformulation for the other techniques].

For Logic techniques such as a predicate calculus representation the wf-frame network component is a nodes of clauses, the rules are just one resolution principle rule and the operators are the unification and resolvent procedures. There will necessarily be a th-frame where the network component will be the negation and the rule will be special while the operators are empty by definition .The handling of the technique will be the proof rule with an indication to keep track of necessary operations (indicated by the th-frame rule). The layers of semantic will include an interpretation for the different literals and functions used.

(i) being mathematically well defined.

(ii) having powerfut incoorporated semantics.

(iii) allowing extendability with ease especially to take care of odd cases. ...

One more ingredient has also popped out during the last decade illustrating dissatisfaction with all of the existing techniques. This is the fact that knowledge to be accessed, acquired, retrieved, updapted or reasoned with should also allow to be undeterministically interacted with. The last ingredient certainly expects to take over as the measure of intelligence of any system.

Definition

Syntax of the ND-technique denoted by DN^j_I (x,y,z) is defined by:

-wf-frames, a well formed frame is a three component structure, network, rules and operators with two way links between each of the network and rules, and the operators and rules; such that the network acts as the memory of the knowledge, the rules are the control manipulators and the operators act as an executive.

-(special frames with only one special rule and no operators will be termed th-frames theorem like frames).

-layers- a layer is a three unconnected component structure, the general, the model and the specializer; where the general is a set of results in one particular domain, the model is a set of interpretations over the given domain and the specializer is a defined interpretation/result.

The handling of the knowledge is syntactically governed by the general concept of deductions where a new wf-frame is formed using old wf-frames and layers. These new wf-frames are formed by one of two rules:

-proof-rules, in that case a new wf-frame is always generated using other existing wf-frames with the aid of their rules and executive operator. Manipulation will usually contine until the generated frame matches an existing th-frame. Keeping track of all steps performed by the executive, will formulate a sort of answer or procedure of solution to a problem according to the situation while the final frame indicates the certainty of the assertion raised.

-interrupt-rules. in that case an evaluation step is first required to decide whether undeterministic behaviour is expected in which case a special th-frame and special procedures are to be generated.

Semantics of ND-technique is naturally incoorporated through the layers and corresponding matching rules. The symbols are interpretted as follows:

(i) denotes the rules of handling (O-proof, 1 interrupt)

(j) denotes the complexily of layer y.

y denotes the type of layer to be considere-ed.

x denotes the wf-frame to be chosen (O-general, 1 of logic, 2 of semantic networks, 3 production rules, 4 frames, if all techniques be considered and wf-frames be built for each- this will necessarily match and the choice of the layer) and

z denotes the choice of technique for interpreting a wf-frame according to a speicific layer, it is the actual semanic component (the present version uses one technique of word matching going through the model of the layer; its power lies in using the general through an external procedure for more elaborate information related to the answer of a question for example to be more clear with the interrupt rule case).

ease as well as its modification to cover different classes of problems through the change of rules. Uncertain knowledge may also be accomodated. The main dissatisfaction with those working with the technique came from the fact that rules do not readily lend themselves to knowledge understanding as much of the contextual knowledge is lost and explicitly stating each and every part becomes noeasy task. Ofcourse semantics in general is not well-defined. One good advantage is also the ease of learning especially with the uniformity of the structure. Production system techniques are certainly the only techniques which allow the capturing of knowledge in some specific situation. Some of the most famous expert systems built using production rules are DENDRAL, MYCIN, and PROSPECTOR.

2.4. Frames

The frame technique was first presented in the work of Minsky in the seventees being dissatisfied with previous techniques. He states that the need for frames rised from the fact that most theories both in artificial intelligence and in psychology were too minute, local and unstructured in comparison to commonsense thought [4]. Unlike previously presented techniques it is not completely different, for in some sense as will be shortly clear it is a generalization of the semantic network technique. The frame structure is some decomposable chunk that is sometimes referred to in literature by either a structure or a schemata. Although its application has found its way in natural languge understanding as well as computer vision applications of Artificial Intelligence it is still not well defined and users find difficulty in its implementation. In the case of knowledge of events it is particularly useful.

The structure of the frame to be filled by actions mainly consists of the basic chunck and some specified slots. Besides matching knowledge is derived by inferences, the point being when, and how they be applied. Development of the technique incoorporated some procedural oriented frames in the context of debating the procedural / declarative contraversary. In terms of logic, frames are structured sets of components of situtaions defined by their slots. A main advantage that rises with the slots is the comcept of default knowledge that naturally exists. In addition, there exists a linkage between facts showing that frames are the first step of generalization to a previous KR-technique, namely the semantic network technique. It is then clear that semantics is naturally incoorporated through the slots and linkages and properties are easily inherited. Each slot can have any number of procedures attached to it. Along with default knowledge, frames also offer a sense to the completion of the problem. Extendability through the slots is surely possible but with caution to keep the frame heirarchy in tact with the explicit relations. One main disadavantage is none existance of formalized methods of search for a collection of frames besides the fact that the knowledge to be stored is not well defined. Generally speaking vagueness was associated with the objective of allowing the handling of large amounts of knowledge.

3. ND-Technique

Before introducing the new technique few commets are in order. As mentioned in the previous section, logic techniques are mathematically well defined, production system (or rule) techniques take care of odd cases easily, and semantic networks and frame techniques are able to naturally incoorporate semantics especially of time, place and acts. It is then only natural to require a new KR technique better than the existing ones in the sense that it will be characterizes by the following:

where each clause is formed by a group of literals derived in a special form from the initial assertions expresed as well-formed-formulae, wiffs, The logic formed is a natural extension to relational database models and its application extended to the definition of formal query languages, the treatment of incomplete information (null values), in databases, and the definition and enforcement of integrity constraints. The second main attack to the technique was the use of pridicates instead of complex structures for the representation. The next advancement was then the inclusion of time factors by using plans. The questoin of combinatorial explosion of the search is still of concern. A last objection is default knowledge. If the system is to respond to assertions only, then questions about nonexisting items may be solved as empty indicating either the answer is negative or nonexisting. As for the question of reasoning about knowledge, model logic has been limitedly used so has temporal logic for future predication.

2.2 Semantic Networks Representation

Semantic networks techniques were introduced in the early sixtees. The general frame work is the notion of a node and a link. Today there are many kinds of networks with special links and inference procedures to act upon the nodes through the links [2,3,9]. Obviously semantics is incooproprated with the structure of the network; hence the name semantic net. However, only when complete algorithms be specified that semantics be complete. While the last restriction is a means to limit combinatorial problems, it forms a restriction on the generality of the technique and in particular of the algorithms. This also allows the variation of semantics, another major disadvantage. There is no agreed upon semantic notion. Meaning is assigned to a network structure only by the nature of the procedures that manipulate the network. At advantage is the technique for representing well-established taxonomies, as well as for natural language research in general.

In short, semantic networks tack advantages of formal definitions and behaviour found in logic. As a matter of fact no other technique has the mathematical power of logic. However, Artificial intelligence research makes good use with networks in heirarchies. From the viewpoint of the predicate calculus nodes and links correspond in some sense to terms and relations. Reasoning is based on matching structures. It goes without saying that matching needs to be perfect.

2.3. Production Systems Representation

Production systems (or called production rules) technique of representing knowledge differs completely in structure from previously discussed techniques They were first introduced by Newell, inspired by human models of thought. It consists of a set of production rules that act on a short term memory (say a database) under specified media (specified by an interpretter) of choice of application of rules [2,9]. The rules are then necessarily two-component, condition and action. The last fact allowed for its fast spread of use in general knowledge rule-based systems. Again the technique is very powerful in case of form and state transitions but it lacks internal structure dependancy. Interpretation is also not always readily formed. Manipulation using rules is usually continued until a goal be found or a state of no-rule applicable is reached. At advantage is the interpretter which allows the choice of rules undeterministically.

The production system technique has proven powerful in quite a number of problem solving problems in real life applications. Another main advantage is its modularity allowing its extension with

jective is always to help formulate knowledge to facilitate its acquisition, retrieval as well as being able to reason about the knowledge each in some specific field. The introduction of new techniques became necessary and semantic networks, production rules and frame-techniques came into existance. Nevertheless, the question still open is there one generalized technique to suit all fields of application with ease. This question forms a contraversary between researchers. Reformulating the ques-techniques and then generate a new mathematically sound technique. Researchers in the field of (AI) believe that the key issue to any break through in the field is knowledge representation (KR) Knowledge representational techniques in existance to date are still not satisfactory.

The following section briefly reviews the main knowledge representation techniques. Next in section three the new generalized ND-technique is mathematically defined illustrating both its syntax and how senantics is incoorporated. This is followed by a discussion for the implementation of the technique in any expert system. Finally, the work concludes with an example illustrating its power besides its generalization in the sense that existing techniques may be incoorporated as special cases of the proposed technique.

2. KR-Techniques

The different knowledge representational techniques known to-data are usually either used alone or in conjunction with others to build expert systems. Each technique provides the system with certain previledges. The well-known of these techniques to be briefly reviewed are logic, semantic networks, production rules and frames.

2. 1. Logic Representation

The logic representation is characterized by defining a symbolic language within which all mathematical propositions could be expressed. A set of truth axioms has been chosen for such a task after which rules of proof that are truth-preserving are applied [1,5,7]. Although the symbolism is not universal to all common sense knowledge, it has been valuable in diverse computational areas, including natural language processing deductive databases, robotics, symbolic integration and expert systems. Its main power lies in the fact that it provides a firm conceptual framework that can formally deal with the notion of logical consequense.

Derived logic is concerned with the inference of truth of propositions from others. This fact is believed to be one basis to human thought. In the field of logic representation itself different order of logic definitions have been introduced with the same basic principles. Logic has been in the works of Turing, Church, Post and Kleen besides the concern of philosophers until it has recently been picked up by Artificial Intelligence researchers. Its mathematical soundness has also attracted the attention of people working in cryptography and distributed computing. A main feature of advantage in implementing logic is that the definition of a notion may itself become an application that solves specialized problems [4]. For example, defining the animals of the zoo, one may discover what is a new species name giving its features; provided it exists. The last remark is the main disadvantage of the logic and negation still forms a problem.

In short logic has a well defined semantics of truth dependent on the interpretation over the domain, a definition of inference and a body of analysis. The syntax is defined by a set of clauses

KNOWLEDGE REPRESENTATION THE KEY TO ARTIFICIAL INTELLIGENCE

Dr. Nevin M. Darwish*

ABSTRACT

This paper deals with the problem of knowledge representation. It is well established that a good representation is the key to simplifying problem solving in general. In the era of computers, a good knowledge representation is the key to computer intelligence for all scientific and commercial applications. A generalized new knowledge representation technique, the ND-technique is presented in this work. First the well known knowledge representation techniques are briefly reviewed. Next the ND-technique in its syntax and semantics is discussed in detail. The technique is shown to be global and can incoorporate other techniques as special cases. More important it introduces grounds for standardization and extendability; hence enabiling a sound mathematical formulation. The work then concludes by the superiority of the technique in its suitability to a large if not all fields of applications.

1. INTRODUCTION

The era of computers has witnessed a fast development both in the hardware area as well as the software area. Nevertheless, the software is still far from satisfaction to humans. The most intelligent computer is still a goal that is interesting researchers. Artificial Intelligence (AI) may be looked upon as the technique intended to build expert systems. If it is an expert system, the programming is the simplest part of the application. The more difficult task is finding some way to represent knowledge in the computer program. It is well established that a good problem representation is the way to simplified general solutions. Along the same lines it is being realized that a good knowledge representation is the key to an intelligent computer. An equally difficult task is getting knowledge from an expert in the first place. A well defined technique is then a necessaty. Commercially AI field is growing explosively and becoming a rival of data processing industry[8]. Market money is expected to be in the expert system buisiness. Early applications were troubleshooting and data interpretation. Later applications started in planning, schedulling design systems, intelligent interfaces for complex equipment; database intermediaries that efficiently retrieve information from multiple databases and natural language systems. Vision, speech, VLSI and circuit design are the most complex and recent applications to start. All of applications surely, still need advancements to be achieved only through good knowledge representation techniquse.

The work in the field of knowledge representation goes back to the early ages of machinary even before computers were known to us in the form we see today. Predicate calculus for automatic theorem proving, has been the first of these well defined, mathematical techniques. As the fields of application diversed, more techniques were introduced. The ob-

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for music at low, middle and high frequencies respectively. So both halls can be used mainly for some extent for music.

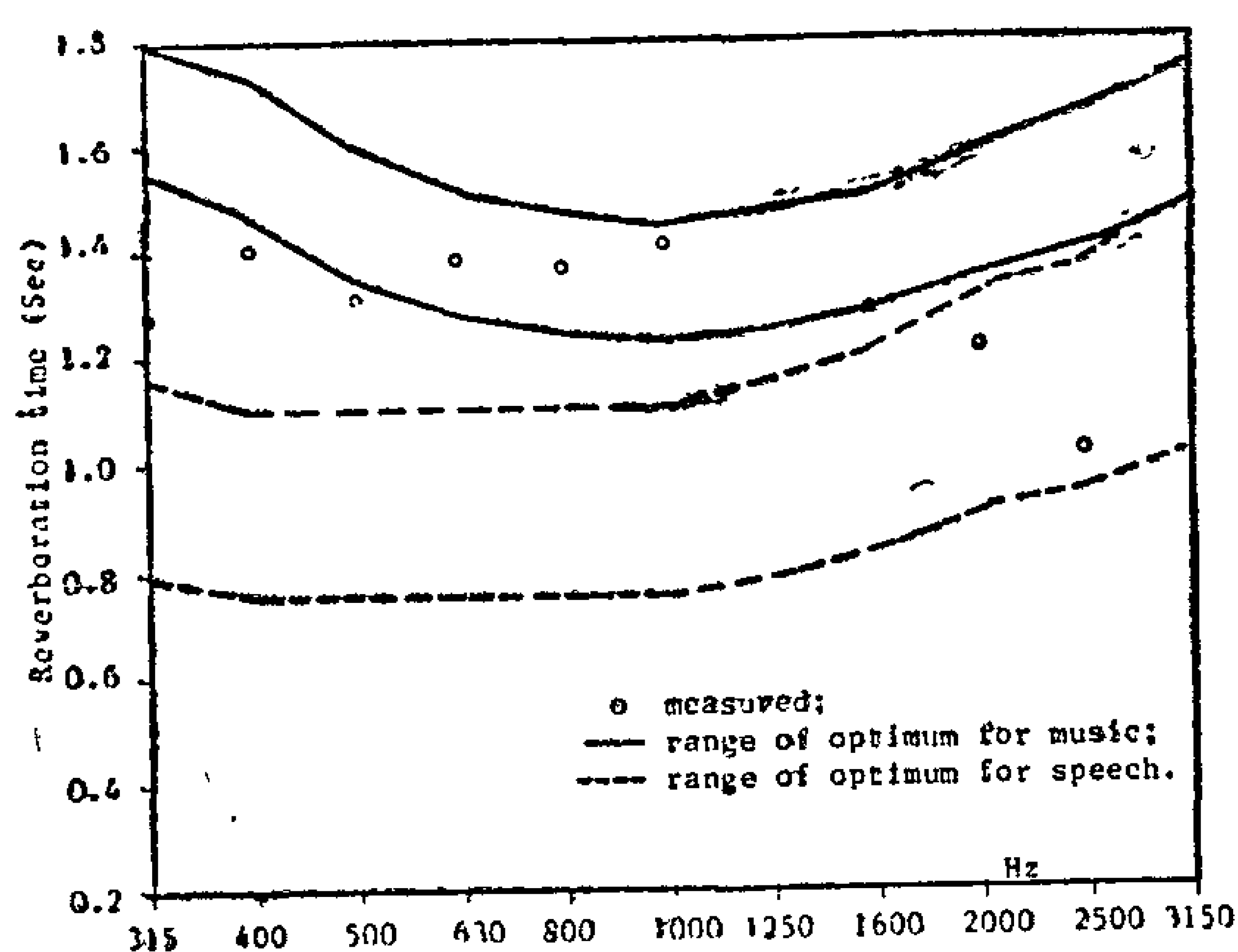


Fig. 7. Characteristic of Reverberation Time of El-Mosafer Khana hall.

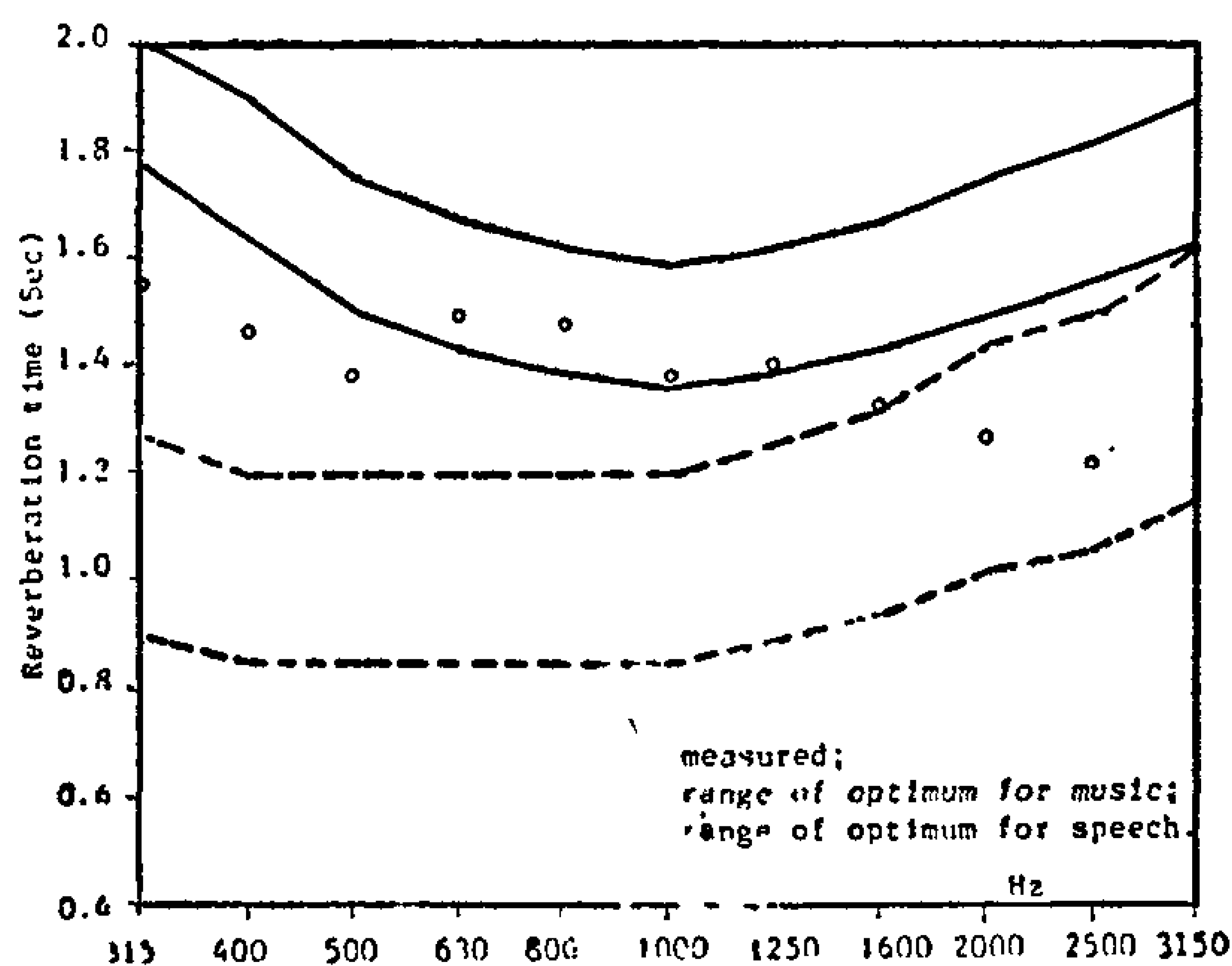


Fig. 8. Characteristic of Reverberation Time of Osman Kutkhuda hall.

The calculated values of C50 stat., C80 stat., and R stat. for both halls at different distances are shown in tables 6 and 7. From these results, it can be observed that, the values of C50 stat. at all places for both halls are smaller than 0 db, which do not satisfy the criteria of good intelligibility of speech. Comparing the calculated values of C80 stat., R stat. for the above halls with the criteria given in table 1, it may be observed that both halls satisfy the degree of quality «useful» for music. Again, there is a good agreement between these results and the conclusion of the reverberation time method. So these halls can be used for some extent for music.

Table 6. C_{50} stat. ,C_{80} stat. and $R_{stat.}$ for El-Mosafer Khana hall.

distance from the sound source (m)	C_{50} stat. (dB)	C_{80} stat. (dB)	$R_{stat.}$ (dB)
7	- 1.4	1.3	3.8
14	- 1.7	1	4.3

Table 7. C_{50} stat.' C_{80} stat. and $R_{stat.}$ for Osman Kutkhoda hall

distance from the sound source (m)	C_{50} stat. (dB)	C_{80} stat. (dB)	$R_{stat.}$ (dB)
7	- 1.03	1.4	3.3
15	- 1.6	1.0	4.2
22	- 1.7	0.9	4.4

CONCLUSION

On the basis of measurments of the reverberation time and the calculation of the satistical parameters C50 stst., C80 stat., R stat., it was found that the Islamic halls of small volume can be used mainly for speech or for some extent for music. Halls of meduim volume can be used for speech or music with a low degree of acoustical quality. On the other hand, halls of large volume can be used mainly for music.

Although the Islamic halls were designed without any acoustical treatments they show suitable acoustical performance. This was achieved by choosing the proper shape, the ratio of the dimensions and the suitable finishing materails.

In addition, the results show a good agreements between the method of reverberation time and the method of satistical parameters.

Table 4. C_{50} stat., C_{80} stat., and $R_{stat.}$ for El-Soheimy hall.2.

distance from the sound source (m)	C_{50} stat. (dB)	C_{80} stat. (dB)	$R_{stat.}$ (dB)
3.5	1.88	4.91	0.9
8	1.2	4.45	1.8
11	1.1	4.39	1.92

Fig. 6 shows the comparison between the measured values of the reverberation time with the permissible ranges of the optimum reverberation time for speech and music in Mostafa Gaafer hall. It is obvious that the measured values of the reverberation time of mostafa Gaafer hall lie nearly at the boundry of the upper limit of the optimum reverberation time range of speech at low and high frequencies, while it lies nearly at the boundry of the lower limit of the range of the optimum reverberation time for music at middle frequencies.

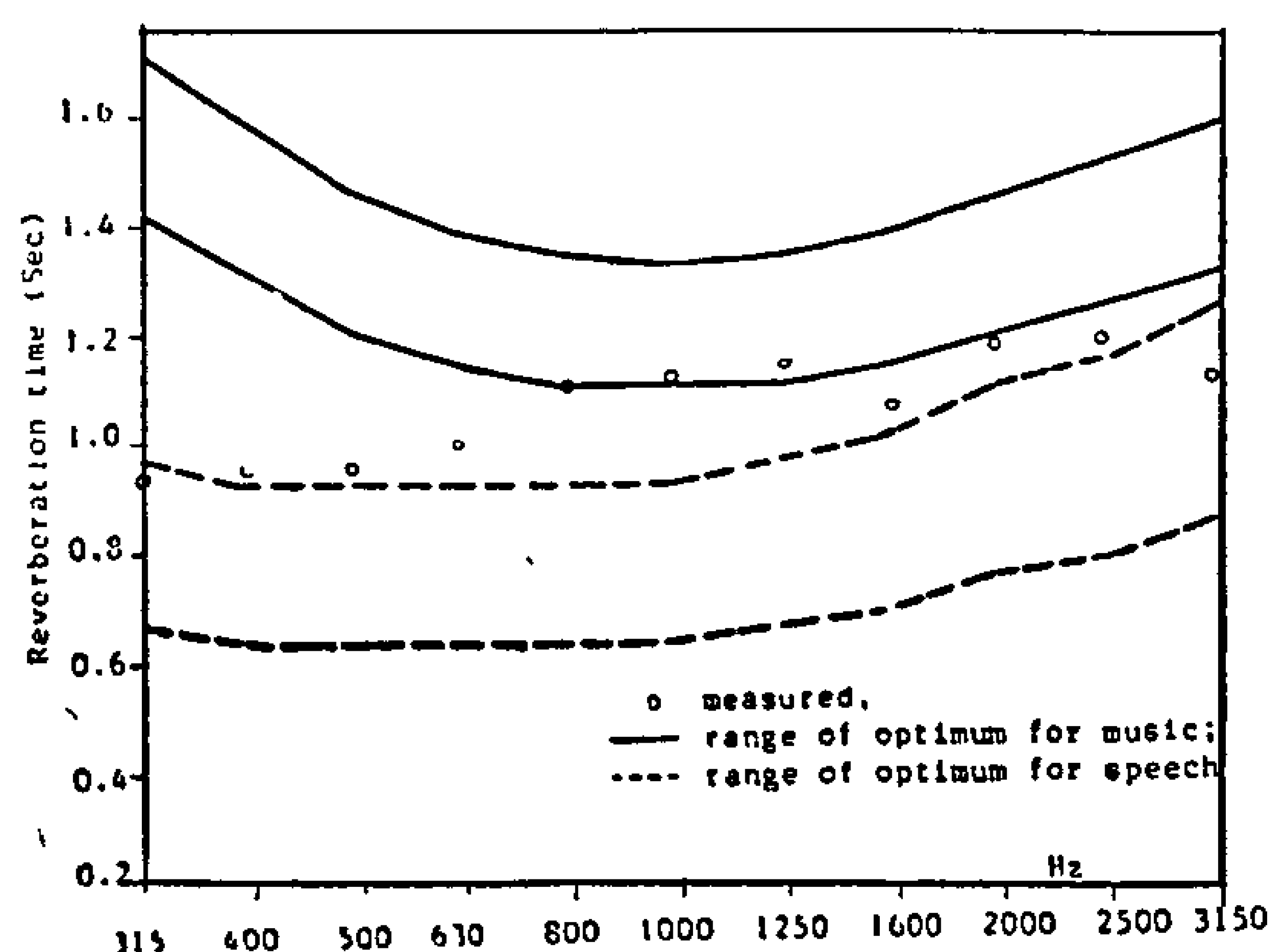


Fig. 6. Characteristic of Reverbration time of Mostafa Gaafer hall.

Table 5 gives the calculated values of C50 stat.C80 stat., and R stat., at different places for Mosfafa Gaafer hall. It can be observed that C50 stat. is about 0 db, which lies just at the lower limit of the good intelligibiliy criteria for speech. The relization of 0 db for C50 stat. for the above hall can be explained as follows: by increasing the volume of the hall, the level of the direct sound will be decreased due to the attenuation for a great distance. In addition, the amount of early reflections within the first 50ms will be decreased, while the amount of late reflections for interval from 50ms to infinite will be increased.

Table 5. C_{50} stat., C_{80} stat. and $R_{stat.}$ for Mostafa Gaafer hall.

distance from the sound source (m)	C_{50} stat. (dB)	C_{80} stat (dB)	$R_{stat.}$ (dB)
7	0.2	3.2	2.6
13	0.04	3.1	2.8

Comparing the caliulated values of C80 stat and R stat. for Mostafa Gaalfer hall with the criteria given in table 1, it can be said that, the degree of quality for this hall for C80 stat. is good while it is «useful» for R stat. These results are in good agreement with the conclusion of the reverberation time method. So groop B can be used for speech with just satisfactory condition for intelligibility or for music with «useful» degree of quality.

C : Halls with relatively large volume, greater than 800 m^3.

For this group the following halls will be discussed:

— al-Mosafer Khann hall with volume of 838 m^3.

— Osman Katkhuda hall with volume of 1781m^3.

Fig. 7 and 8 illustrate the measured values of the reverberation time for speech and music for both halls. It can be observed that the measured values of the reverberation time lie just at the lower limit, within and outside the permissiable range

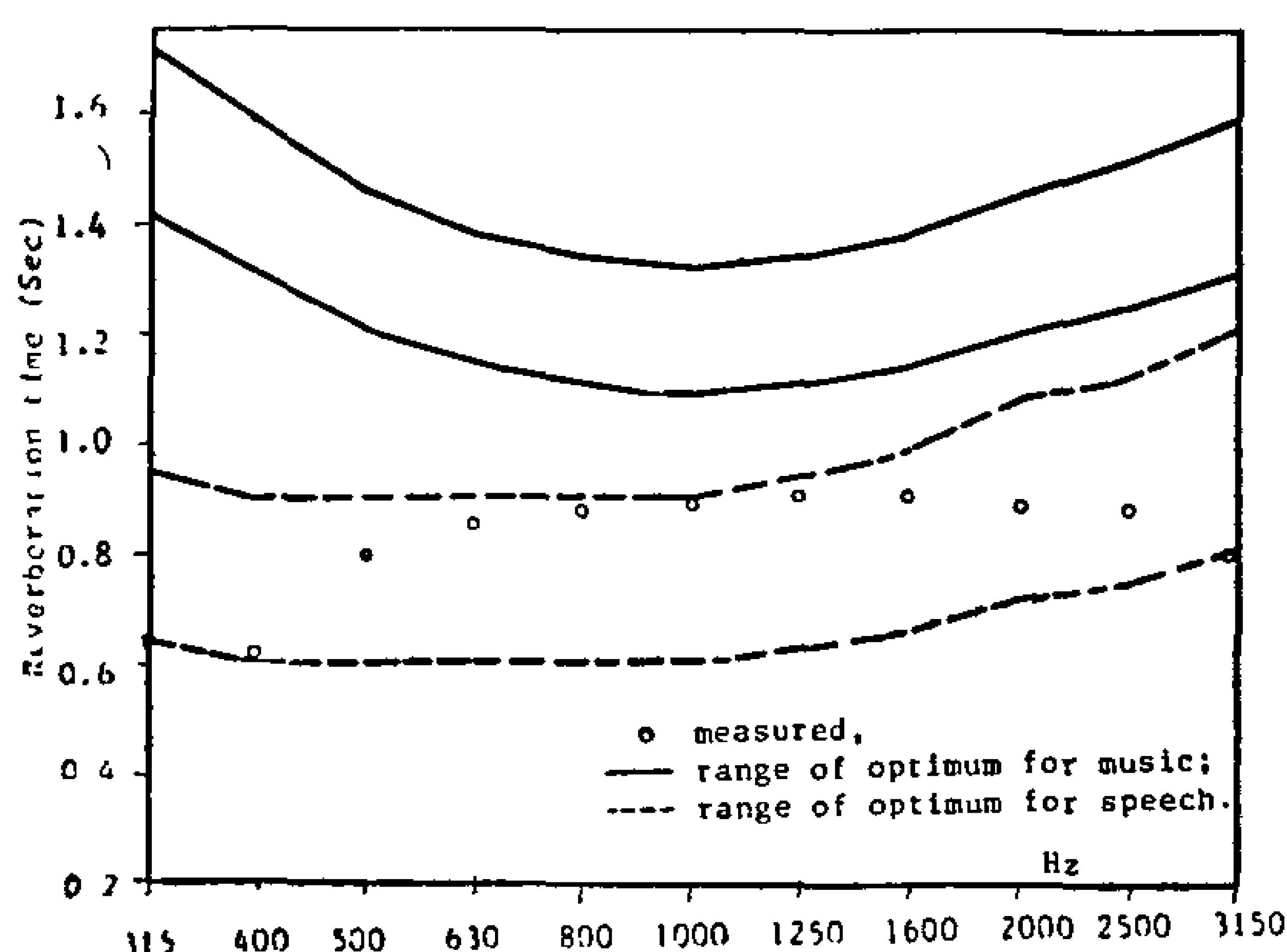


Fig. 5. Characteristic of Reverberation Time of El-Soheımy hall 2.

In addition, the statistical parameters C50 stat., C80 stat., and R stat. are calculated according to the equations (1), (2) and (3) at different distances from the sound source for the above halls. The calculated values are compared with the criteria of C80 and R for music shown in table 1 and with the criteria of C50 which states that, C50 greater than zero db for good intelligibility of speech. Tables 2,3 and 4 show the calculated values of the statistical factors of al-Soheimy hall 1, al-Harim hall and al-Soheimy hall 2 respectively.

Table 1. The range of degree of quality of spatiol factor R and clarity factor C_{80} at different lastening places.

degree of quality	Spatial factor R		Clarity factor C_{80}	
	Place		Place	
	Front	Back	Front	Back
good	(-5....0) dB	(-2....4) dB	(3....8) dB	(0....5) dB
useful	(0....6) dB or < -5 dB	> +4 dB or (-6....2) dB	(-2....3) dB or > +8 dB	(5....9) dB or (-5....0) dB
not-useful	> +6 dB	< -6 dB	< -2 dB	> +9 dB

From these tables it can be noticed that C50 stat greater than 1db for all places which satisfy the criteria for good intelligbility of speech. This high values of C50 stat. may be due to the following reasons :

a) The halls have small dimensions, so the level of the direct sound is high enough.

b) The early reflections occur within interval of time less than 50 ms because all the dimensions of the halls are less than 17 meters which corresponds to 50 ms.

c) Most of the walls are from stone which is a good reflective surface, so the level of the early reflections is high.

As shown in tables 2,3 and 4, all the calculated values of C80 stat. at the different places lie within the range from 4 to 6 db, which corresponds to degree of quality «good» according to table 1. On the other hand, the calculated values of R stat lie within the range 0—2 db, which corresponds to the degree of quality useful according to table 1. Hence, it can be said that the al-Soheimy hall 1, al-Harim hall and al-Soheimy hall 2, can be used mainly for speech and in some extent for music

B : *Halls with relatively medium volume* namely 400-800m3

This group includes :

Mostafa Gaafer hall with volume of 435 m3.

Table 2. C_{50} stat., C_{80} stat and R_{stat} for El-Soheimy hall 1.

distance from the sound source (m)	C_{50} stat. (dB)	C_{80} stat. (dB)	$R_{stat.}$ (dB)
2	2.48	5.4	0.06
5	1.2	4.4	1.75
9	1.06	4.3	1.98

Table 3. C_{50} stat, C_{80} stat. and R_{stat} for El-Harim hall.

distance from the sound source (m)	C_{50} stat. (dB)	C_{80} stat. (dB)	$R_{stat.}$ (dB)
5	2.6	6	0.6
9	2.3	5.8	0.97

$$C_{50\ stat.} = 10 \log \frac{\left(\frac{r_H}{r}\right)^2 + 1 - e^{\frac{-0.69}{T}}}{e^{\frac{-0.69}{T}}} \text{ db}$$

$$C_{80\ stat.} = 10 \log \frac{\left(\frac{r_H}{r}\right)^2 + 1 - e^{\frac{-1.1}{T}}}{e^{\frac{-1.1}{T}}} \text{ db}$$

$$R_{stat.} = 10 \text{ Log} \frac{0.88\, e^{\frac{-0.345}{T}} + 0.12\, e^{\frac{-1.1}{T}}}{1 + \left(\frac{r_H}{r}\right)^2 - 0.88\, e^{\frac{-0.345}{T}} + 0.12\, e^{\frac{-1.1}{T}}} \text{ db}$$

Where:

r_H: Reverberant raduis $\simeq \sqrt{\frac{A}{50}}$

T : The measured reverberation time at middle frequently in sec.

r : Distance between the sound source and the place at which the statistical parameters are calculated, ...

A : Sound absorption unit in m².

RESULTS AND DISCUSSION

The walls of all mentioned halls have the same material, namely stone. Therfore the halls may be classified according to their volumes. Hence the above halls can be devided into the following groups:

A : Hall with small volume 200-400³),
this group includes:

— al-Soheimy hall 1, with volume of 245 m³.

— al-Harim hall in al-Keredli palast with Volume of 364 m³.

— al-Soheimy hall 2, with volume of 390m³.,

Fig. 3,4 and 5 represent the maximum and minimum values of the optimum reverberation time of the different frequencies for speech and music in comparison with the measured values of the reverberation time in al-Soheimy hall. 1, al-Harim hall and al-Soheimy hall 2, respectivily. It may be noted that the measured reverberation time in al-Soheimy hall 1, lies nearly at the upper limit of the optimum reverberation time for speech at low and medium frequencies while it lies approximately within the permissible rang at high frequencies. Also, the measured reverberation time in al-Harim hall and al-Soheimy hall 2, leis approximately within the permissible range of the optimum reverberation time for speech. This means that the above halls are manily suitable for speech purpose to satisfy the optimum acoustical performance.

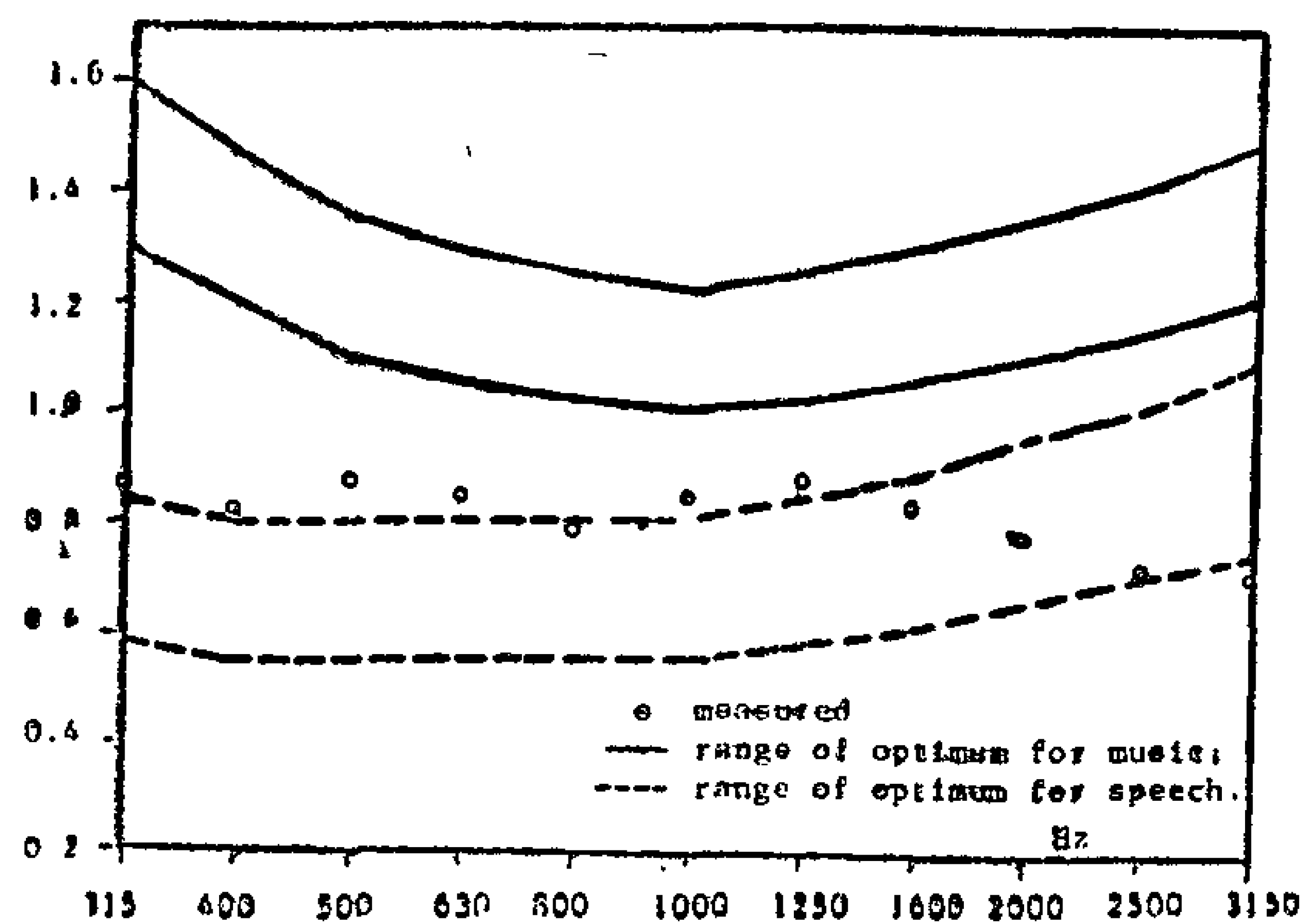


Fig. 3. Characteristic of Reverberation Time of El-Soheimy hall 1.

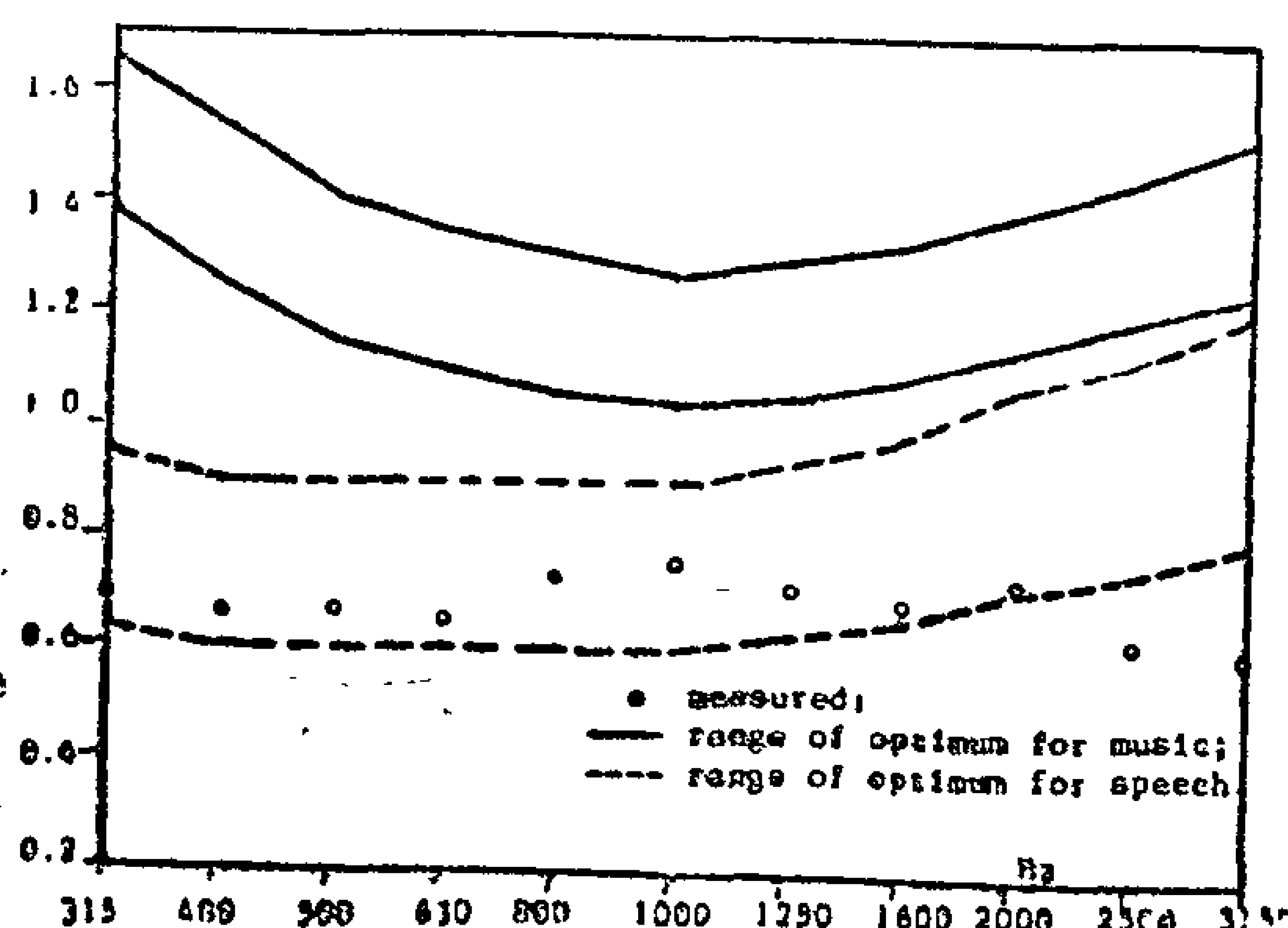


Fig. 4. Characteristic of Reverberation Time of El-harim hall,

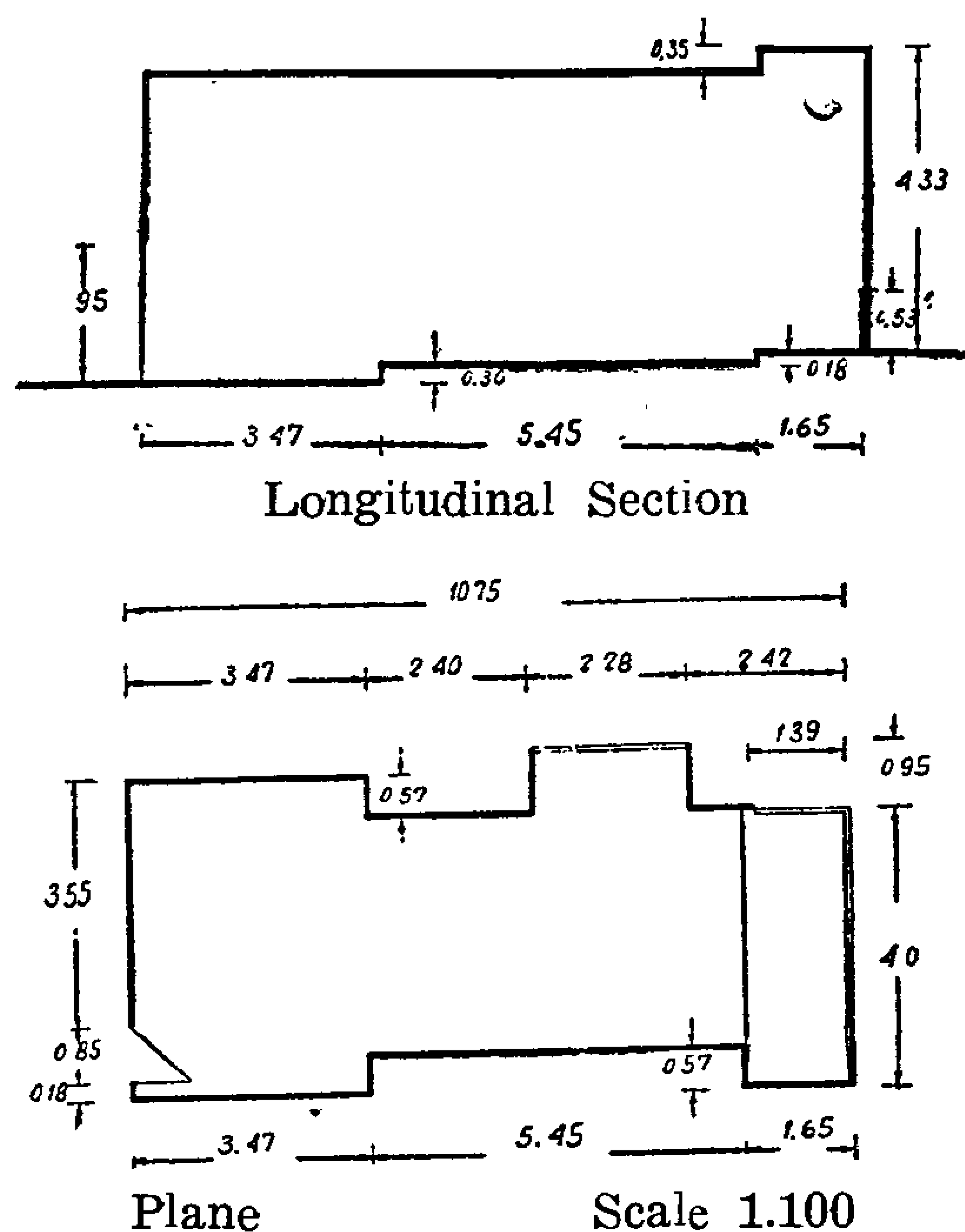


Fig. 1. The longitudinal section and the plane of the al-Soheimy hall 1.

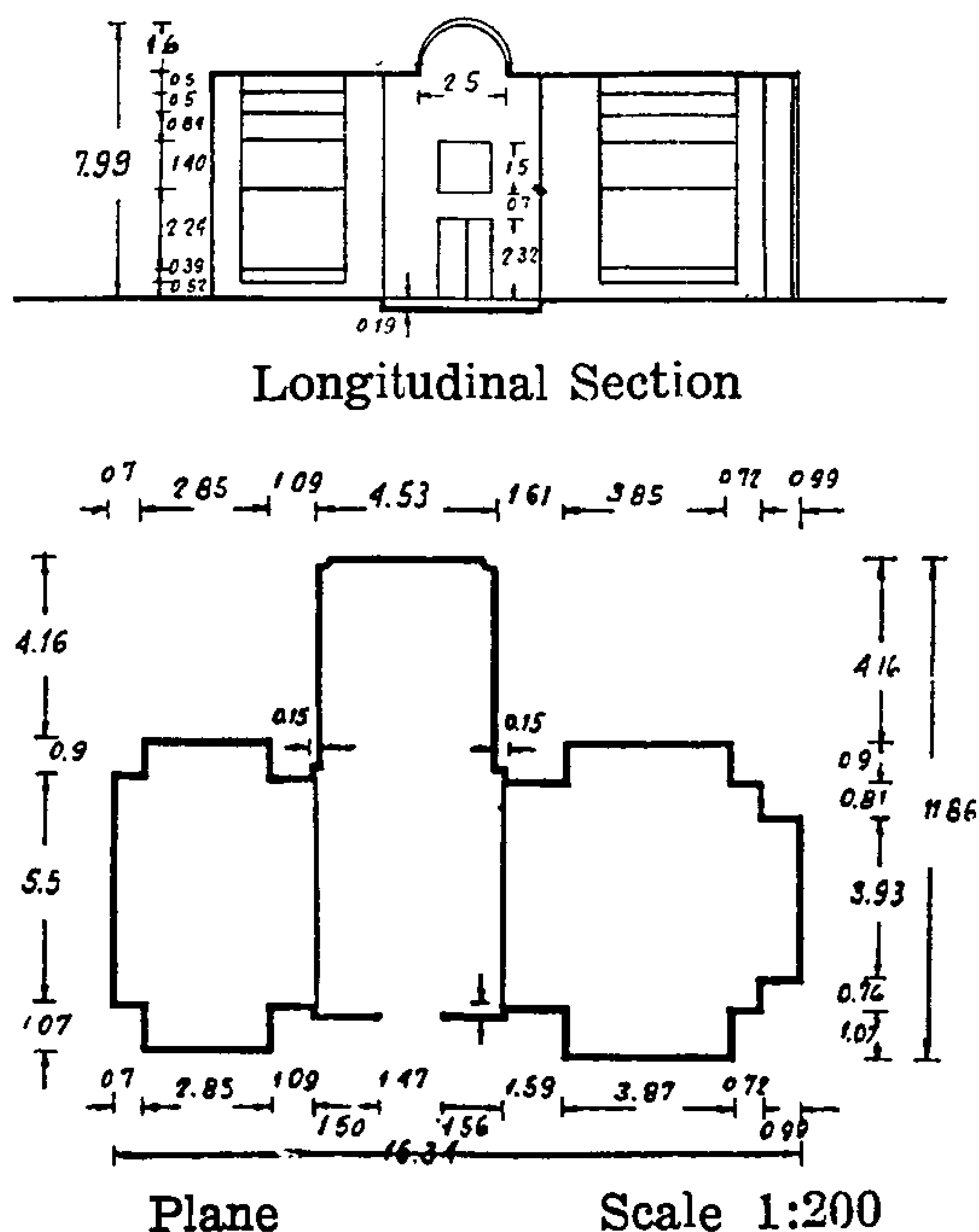


Fig. 2. The langitudinal section and the plane of the al-Mosafer Khan palast.

FIELD MEASURMENTS

The measurements of the reverberation time in the halls of Islamic buildings were carried out in six diferent halls. The sound source, type 4204 (Bruel, Kjear), in connection with the building acoustic analyser type 4417, excites the hall to a steady state with a third-octave filtered noise single. The sound pressure level produced in the room is adjusted to that it is at least 40 db above the back-ground noise level in all the frequency bands of interest in order to obtain an adequate decay curve.

The building acoustic analyser analyses the microphone single through a second set of a 1/3 octave band filter and calculates the reverberation time from the decay curve Since the reverberation time can vary from place to place, the receiving microphone should be placed at several positions in the room. Here eight samples were taken in each frequency band and the average of the reverberation time for each frequency band was deduced.

METHODS FOR CHECKING THE ACOUSTICAL PERFORMANCES

The check of the acoustical performance of the Islamic halls are carried out by two methods:

1. The reverberation time method

In this method the. reveration time at different frequencies were measured for each hall and then compared with the optimum ranges of the reverberation time for speech and music[3,4].

2. The intelligibility, clarity and spatial factors method

In this method the statistical intelligibility factor C50 stat., the statistical clarity factor C80 stat., and the statistical spatial factor R stat., were calculated for each hall acccording to the following equations[6]:

ACOUSTICAL PERFORMANCE OF HALLS IN ISLAMIC BUILDINGS

Dr. A. ELMALLAWANY*, Dr. M. EL MESSIRY*

SUMMARY

The physical and acoustical features of any hall, such as its size, shape and its finishing materials affect its acoustical performance taking into consideration the functional use of the hall.

The Islamic architecture is known with its characteristic feature design. This feature design has its own effect on the acoustical performance of building.

A field investigation was carried out on some Islamic halls. The characteristic reverberation time was measured. In addition, the statistical acoustical parameters, namely the statistical intelligibility factor C50 stat., the statistical clarity factor C80 stat., and the statistical spatial factor R stat., were calculated. The results were compared with the criteria of optimum for speech and music.

INTRODUCTION

The object of this article is to study the acoustical performance of the halls in some Islamic buildings which were built in the period from 14th to 18th. Contury[1,2]. As it is known, up till now, there are three main factors which restrict the architect in the design of the Islamic building in this period. These factors are : environment, social and religion factors. These halls are used mainly as meeting, reception and sometimes for singing, i.e. multi-purpose halls. The modern design of the multi-purpose halls requires variable sound absorbing materials for acoustical treatment. In addition, sound amplification system may be used. All these acoustical approaches were not used in the Islamic period. The modern acoustical factors such as the reverberation time[3,4], the intelligibility factor[5,6], the clarity factor and the spatial factor are measured for some Islamic halls. The above acoustical factors are compared with the standard permissible values to check their acoustical performance.

TEST OBJECT

The acoustical measurement were carried out on the following halls :

1. Osman Katkhuda hall.

It is considered as the oldest hall, which was built in year 1350. It lies in Beat Al-Kady street.

2. al-Keredli palast.

It was built in the period from 1631-1632 and it lies beside Ibn-Tolon house.

3. al-Mosafer Khan palast

It was built in 1779 and, it lies in al-Gamalia street.

4. Bayt al-Soheimy

It was built in the period from 1648 to 1748 and it lies in al-Derb al-Ahmer, al-Gamalia street.

As an example, figs. 1 and 2 show the longitudinal section and the plane of some halls.

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وزارة التعمير والمجتمعات الجديدة والإسكان والمرافق

هيئة القطاع العام للتشييد

- هيئة القطاع العام للتشييد إحدى هيئات وزارة التعمير والمجتمعات الجديدة والإسكان والمرافق، وقد أنشئت بالقرار الجمهوري رقم: ٤٦٧ لسنة ١٩٨٣
- تقوم الهيئة بالإشراف على ٢٦ شركة متخصصة في أنشطة مقاولات التشييد والمباني والأعمال المدنية والمرافق والتركيبات والأساسات الميكانيكية والأعمال البحرية والمباني الجاهزة والأعمال الصحية وغيرها.
- يتبع الهيئة أيضاً « المكتب العربي للتصميمات والإستشارات الهندسية » وهو أكبر بيت خبرة مصري في هذا المجال.
- يعمل بالهيئة وشركاتها أكثر من ثلاثة آلاف مهندساً من مختلف التخصصات كما يعمل بها أكثر من ٣٠ ألف (ثلاثون ألفاً) من الفنيين والمساعدين والعمال
- تقوم شركات الهيئة بتنفيذ أعمال في كل عام قيمتها حوالى ٥٨٢ مليون (خمسمائة واثنين وثمانون مليون جنيه) في مجالات الإسكان والمرافق والخدمات والمصانع والمطاحن والجامعات والمدارس والمنشآت السياحية
- قامت شركات الهيئة خلال المدة من ٨٧/٧/١ حتى ١٩٨٨/٦/٣٠ بتسليم ١٩٦٧١ « تسعة عشر ألفاً وستمائة واحد وسبعون » وحدة سكنية كاملة المرافق بمختلف المحافظات.
- لكسر الإحتكار الأجنبي طرقت الهيئة مع شركاتها مجالات المشروعات الكبرى والتي كانت مقصورة على شركات المقاولات الأجنبية وأمكن قيد إتحاد شركات هيئة القطاع العام للتشييد في سجل المقاولين المقبولين لدى الأجهزة التنفيذية للمشروعات الكبرى مثل الجهاز التنفيذي لمشروعات الصرف الصحي للقاهرة الكبرى ومشروعات مصانع الأسمنت وغيرها.
- تمتلك شركات الهيئة مقومات عديدة يمكن أن تساهم في تنفيذ خطط التنمية في مصر والبلاد العربية الشقيقة منها على سبيل المثال:

عدد ٢٢ ورشة نجارة بها ٤٩٢ ماكينة مختلفة الأغراض
» ١٥ ورشة كاملة للكريتال والألومنيوم
» ٢١ مصنع طوب أسمنتي
» ١٦ مصنع وورشة رخام وبلاط

بخلاف ما تمتلكه من محاجر وآلات ومعدات

- يرأس مجلس إدارة الهيئة المهندس/ **محمد محمود علي** ويعاونه ثلاث نواب، أحدهم للشئون الفنية، والثاني للشئون المالية والإقتصادية، والثالث لشئون التنمية الإدارية



هيئة القطاع العام للصناعات المعدنية

شركة النصر للمسبوكات

نعتبر شركة النصر للمسبوكات من الشركات الرائدة فى انتاج الزهر المرن على مستوى الجمهورية حيث قامت بإدخال أحدث تكنولوجيا لانتاجه وهى طريقة « الفورتكس » بالاشتراك مع مركز بحوث وتطوير الفلزات ويعتبر انتاج هذا النوع من الزهر أحد إنجازات العصر الهندسية حيث أن مجموعة خواصه الميكانيكية من قوة الشد واجهاد الصمود والمطولية تفوق مثيلتها فى كل المسبوكات الحديدية المعروفة بما فيها الصلب والزهر الطروق .

ويمثل عام ١٩٨٧ بالنسبة للشركة أهمية خاصة حيث زادت الطاقة الانتاجية للشركة من ٢٥٫٠٠٠ طن إلى مايقرب من ٧٥٫٠٠٠ طن سنويا وترجع هذه الطفرة إلى البدء فى تشغيل مشروع انتاج مواسير الزهر المرن الذى يهدف إلى فك اختناقات شبكات المياه والصرف الصحى وخدمة مرافق المجتمعات الجديدة ومقابلة التوسع فى خطط الإسكان .

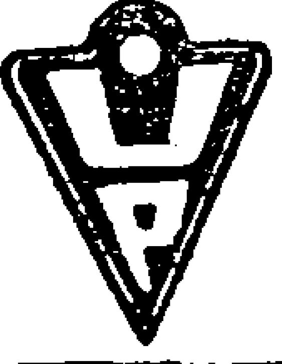
تضم شركة النصر للمسبوكات مجموعة من المسابك تخصصت فى سباكة الحديد الزهر والصلب منذ مايقرب من أربعين عاما، وعلى مدى هذا التاريخ الطويل وضعت الشركة نصب عينيها الارتقاء بمنتجاتها بحيث تصل للمستوكات العالمية معتمدة فى ذلك على خطين متلازمين ، الأول يتمثل فى تطوير معدات الشركة لاستيعاب تكنولوجيات حديثة للصهر واستخدام الطرق الجديدة لانتاج المواسير وما استتبع ذلك من تزويد أقسام الورش الخاصة بتشطيب المنتجات وأقسام مراقبة الجودة بأحدث الأجهزة والمعدات بحيث يكون المنتج النهائى مطابقاً للمواصفات القياسية ، أما الخط الثانى فهو يعتمد على استخدام الوسائل العلمية فى ترشيد الاستهلاك واستغلال الطاقات الانتاجية المتاحة لأقصى درجة

تحل مسبوكات الزهر المرن الآن
محل مسبوكات الزهر الرمادى

وعلاوة على المواسير ومستلزماتها التى تمثل الإنتاج الرئيسى للشركة ، فإن الشركة تنتج مسبوكات أخرى متنوعة تغطى احتياجات قطاعات الدولة المختلفة من مسبوكات الزهر الرمادى المرن وكذلك أنواع الصلب الكربونى والمنجنيزى والسبائكى المقاومة للحرارة والتآكل ويتم صهر هذه السبائك فى مجموعة من الأفران تمثل أحدث ماوصلت إليه تكنولوجيا صهر المعادن وتتيح التحكم الدقيق فى تحليل وخواص السبائك المختلفة ، وتضمن امكانيات الشركة من أفران المعالجة الحرارية ومعدات التشطيب والاختبار انتاج مسبوكات ذات نوعيات متميزة تحقق أقصى مايطمح إليه المستهلك من درجات الأداء العالى .

مصنع القاهرة : بلدة طناش - إمبابة - الجيزة ت : ٣٤٠٣٩٧٨
الإدارة ومصنع الإسكندرية : شارع قنال المحمودية - البر القبلى - محرم بك - الإسكندرية
ت : ٤٩٣٩١٥٦ - تلكس : CASTIN UN ٥٤٤٩

هيئة القطاع العام للصناعات المعدنية

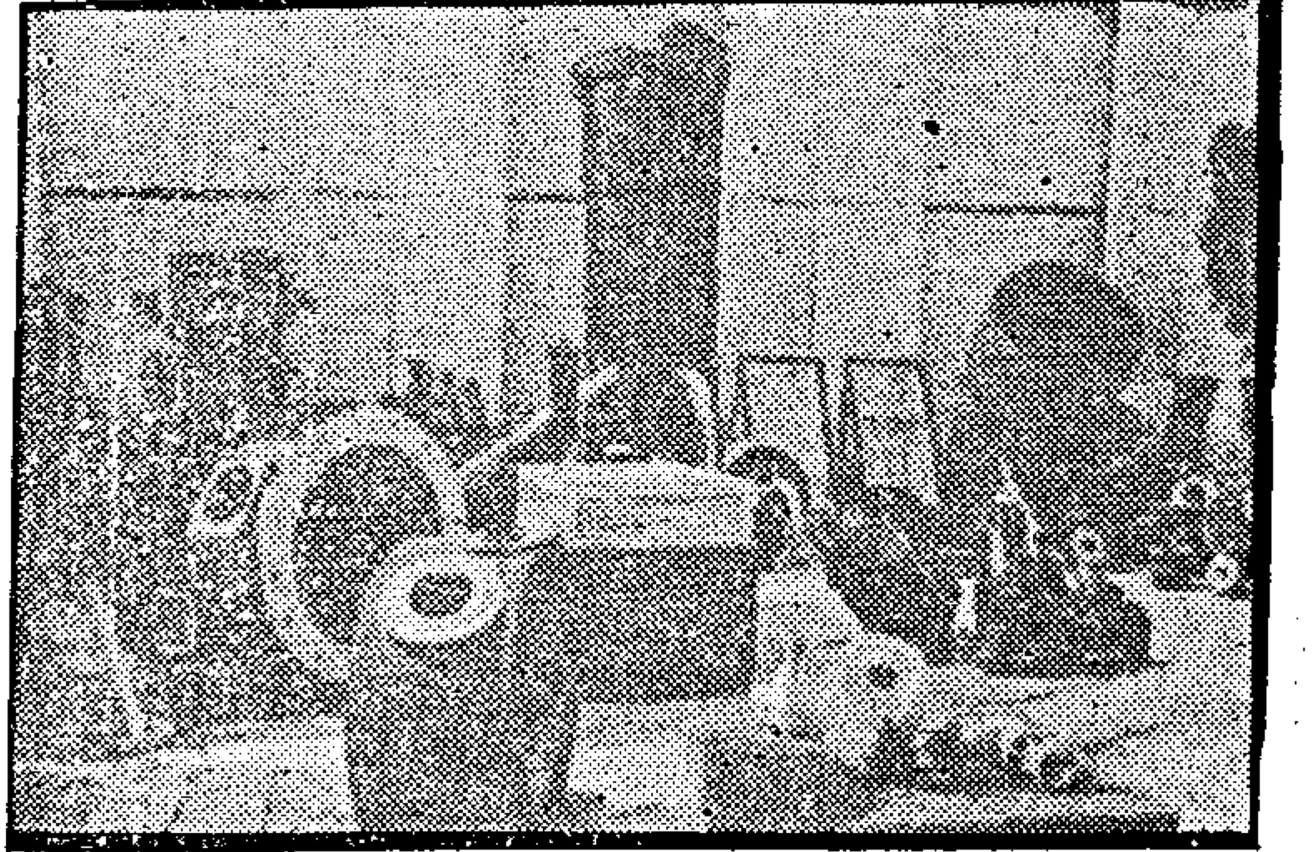


شركة النصر للمسبوكات

تضم شركة النصر للمسبوكات مجموعة من المسابك تخصصت فى سباكة الحديد الزهر والصلب منذ مايقرب من أربعين عاما، وعلى مدى هذا التاريخ الطويل وضعت الشركة نصب عينيها الارتقاء بمنتجاتها بحيث تصل للمستويات العالمية معتمدة فى ذلك على خطين متلازمين ، الأول يتمثل فى تطوير معدات الشركة لاستيعاب تكنولوجيات حديثة للصهر واستخدام الطرق الجديدة لانتاج المواسير وما استتبع ذلك من تزويد أقسام الورش الخاصة بتشطيب المنتجات وأقسام مراقبة الجودة بأحدث الأجهزة والمعدات بحيث يكون المنتج النهائى مطابقاً للمواصفات القياسية ، أما الخط الثانى فهو يعتمد على استخدام الوسائل العلمية فى ترشيد الاستهلاك واستغلال الطاقات الانتاجية المتاحة لأقصى درجة

EL-NASR CASTINGS

للمسبوكات المتميزة ذات الأداء الرائع



ولشركة النصر للمسبوكات فلسفة واضحة تعتمد على التنبؤ باحتياجات قطاعات الصناعة والخدمات المختلفة من المسبوكات والعمل على مقابلة هذه الاحتياجات من خلال تكنولوجيات حديثة للإنتاج ونظام صارم لرقابة الجودة يغطى جميع مراحل الإنتاج



بعض منتجات الشركة

- البلوف ولوازمها وصنابير الحريق من الزهر المرن.
- مواسير الزهر المرن ... أداء عالى فى أقسى ظروف التشغيل.
- أنواع متميزة من الدرافيل من الزهر المرن واختيار السبيكة المثلى لصلب الدرافيل.
- عمل القوالب .. مع رقابة الجودة .. والبحوث والتطوير
- مواسير مصنوعة من أجل المستقبل

مواسير مصنوعة من أجل المستقبل

مشروع جديد بالشركة على وشك البدء فى الإنتاج بطاقة ١٠٫٠٠٠ طن سنوياً طبقاً لتكنولوجيا سويسرية وألمانية متقدمة وهو يهدف لإنتاج البلوف بأنواعها ووصلاتها وكذلك وصلات المواسير وصنابير الحريق البلف السكينة البلف المرحى

- ارتفاع كفاءة الاستخدام وصلاحيته للضغوط العالية
- عمر أطول فى الاستخدام وسهولة فى الصيانة
- الإستغناء عن التنظيف الدورى / انخفاض الوزن وبالتالى السعر

مكتب الإتصال : ١٠ شارع الكامل محمد / الزمالك / القاهرة ت : ٣٤١٨٠٩٣ تلكس CASTIN UN ٩٤٠٨٢
مكتب الإدارة التجارية : ١٤ شارع الصالح أيوب / الزمالك / القاهرة - ت : ٣٤١٢١٩٠

مع تحيات العلاقات العامة بالشركة

MINISTRY OF INDUSTRY
THE GENERAL ORGANIZATION FOR CHEMICAL INDUSTRIES IN THE SLRVICE OF NATIONAL ECONOMY

The Organization covers the activities of 27 companies which Fulfill the requiments of agriculture, industry and services. In the year 87/1988, production value amounted to one thousand five hundred and forty seven million pounds approximately, that is at rate of 109% of the yer's target.

The fulfilment of the fundamental national requirements of chemical materials is the objective, and the way is the technological development.

Chemical industries are the cornerstone in the progress of different industries...this is the fact and basis always repeated by economists in their different schools in our present time therefore, we had to give this sector the priority in our economic plan which has started since thirty six years...beginning with the July Revolution.

The value of production of chemical companies in the year 86/1987 in the different specific divisions of Organization is distributed as follows :

— Fertilizers	;	26,1%
— Paper & Paper converting		17,9%
— Essential chemicals	;	18,3%
— Miscellaneous	;	13,2%
— Plastic products	,	7,4%
— Tanned leather	;	2,7%
— Cellulosic Products	;	6,7%
— Rubber products	;	7,7%
Of total Production		

The Production of the companies apply international stndards of quality, Most of the production of chemical industries is devoted to meeting the requirements of the following productive sections :

- Agriculture
- Mining industry and light industries
- Culture and education
- Transportation and communicacations
- Housing and construction
- Wrapping and packing
- Intermedites
- Sanitary uses

In conformity with this role and the reponsibility, the Organidation, under the Ministry of Industry, follows a policy concentrating on four bases

1. Continued modernization and development of production lines in order to meet the repuirements and rapid variables of the present days.

2. Export promotion by recovering the situation of the Egyptian chemical products in the traditional markets, and also attaining new markets.

3. Reducing the reliance on imported materials and concentrating on the use of local materials.

4. Exerting every effort and capabilities to let the innovative and creative capacity of the Egyptian worker through adopting a firm scientific policy, beside releasing incentives equivalent to the value of the work and application of the principle of reward and punishment...the organization exert strenuous efforts in the service of the Egyptian economy.

is believed by the writers that in order to satisfy the required original water quality, the quantities of drainage water must be reduced further to a point that the entire project would be quesionable.

CONCLUSIONS :

It is concluded based on the presented simple analysis that ,

1. Irrigation water management might greatly affect on the policy of the reuse of drainage water.

2. The quantities of drainage water might be decreased significantly with less quality.

3. El-Omom drain project might be questionable after irrigation water management policy is in effect.

4. El-Salam canal project must be reviewed to ensure the availability of drainage water quantities and quality.

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1. "The Reuse of El-Omom Drainage water for Irrigation Purposes Project", Ministry of Public Work and Water Resources Publications, 1984. (In Arabic).

2. Master Water Plan Project, "Consumptive Use of Crops in Egypt", Technical Report No. 17 (UNDP/EGY/73/024, Ministry of Irrigation, Cairo, Mar. 1981.

1984. It surperisingly shows the low efficiency of the irrigation system (average of 39.14%). This conclusion by itself suggests that increasing the irrigation efficiency is indeed worthwhile and would be a real assist is saving water for the horizontal expansion projects.

Table 1- Water Discharges Used in Irrigation for West Delta from 1977 to 1984

Year	Fresh Water Discharge m.m³/Year	Reused Drainage Water Discharge m.m³/Year	Total Water Discharge m.m³/Year
1977/1978	9331.190	688.150	10019.340
1978/1979	9824.400	696.812	10521.212
1979/1980	9683.328	695.233	10378.561
1980/1981	9914.194	706.021	10620.215
1981/1982	9349.524	646.478	9996.002
1982/1983	9268.024	721.073	9989.087
1983/1984	9698.224	673.090	10371.314
Total	67068.884	4826.847	71895.731
Average	9528.925	693.564	10270.819

Table 2- Water Demands for West Delta from 1977 to 1984 Without Losses

Year	Water Demand m.m³/ Year	Total Water Dis. m.m³/ Year	Efficiency %
1977/1978	4431.910	10019.340	44.23
1978/1979	3771.640	10521.212	35.85
1979/1980	4082.070	10378.541	39.38
1980/1981	4042.890	10620.215	38.07
1981/1982	4205.000	9996.002	42.07
1982/1983	3676.450	9989.087	36.80
1983/1984	3900.550	10371.314	37.61
Total	28110.510	71895.731	—
Average	4015.790	10270.819	39.14

In order to estimte the decrease in the drainage water available for the reuse, due to the proposed irrigation water management plan, a very simple analysis was used. The irrigation water duty can be expressed as,

$$D = Q/A$$

where D is the average irrigation water duty (cubic meter per feddan per year) Q is the total irrigation water available from both fresh water and reused drainage water and A is the total irrigated area. According to the data as presented in table 1 and 2, it was found that the average water duty is 8560 cubic meters per feddan per year. A similar equation could be written to estimate the average drainage water duty. By applying the similar formula, it was found that the average drainage water duty is 6626.862 cubic meters per feddans per year. This value represents 77.4 percent of the irrigation water duty which reflects the misuse of the irrigation water and the low efficiency of the system as well. Note that, the ratio of the drainage water duty to the irrigation water duty recognized by the Ministry of Public Work and Water Resources is 50 percent.

According to the policy of the Ministry, it is expected to reduce the average irrigation water duty to 5500 cubic meter per feddan per year .This means that the duty will be reduced by about 35.74 percent for both the irrigation and drainage water duties

Assuming, of course, that the relation between them is linear which might not be the case. This undoubtedly will increase the salinity of the drainage water.

Now, if we would apply the same procedure to El-Omom drain project, one would find that the amount of water taken from Taroga, Shershera and Abou-Homos drainage pump stations might decrease to 233.46, 303.82 and 102.74 million cubic meters per year respectively. Therefore, the total amount of water available for adding to Nubaria canal would be 640 million cubic meters per year with higher salinity than that expected by the original project. This leads to shortage of about 356 million cubic meters per year which represents a shortage of 14.25 percent of the available mixed water for the expansion area with less quality. It

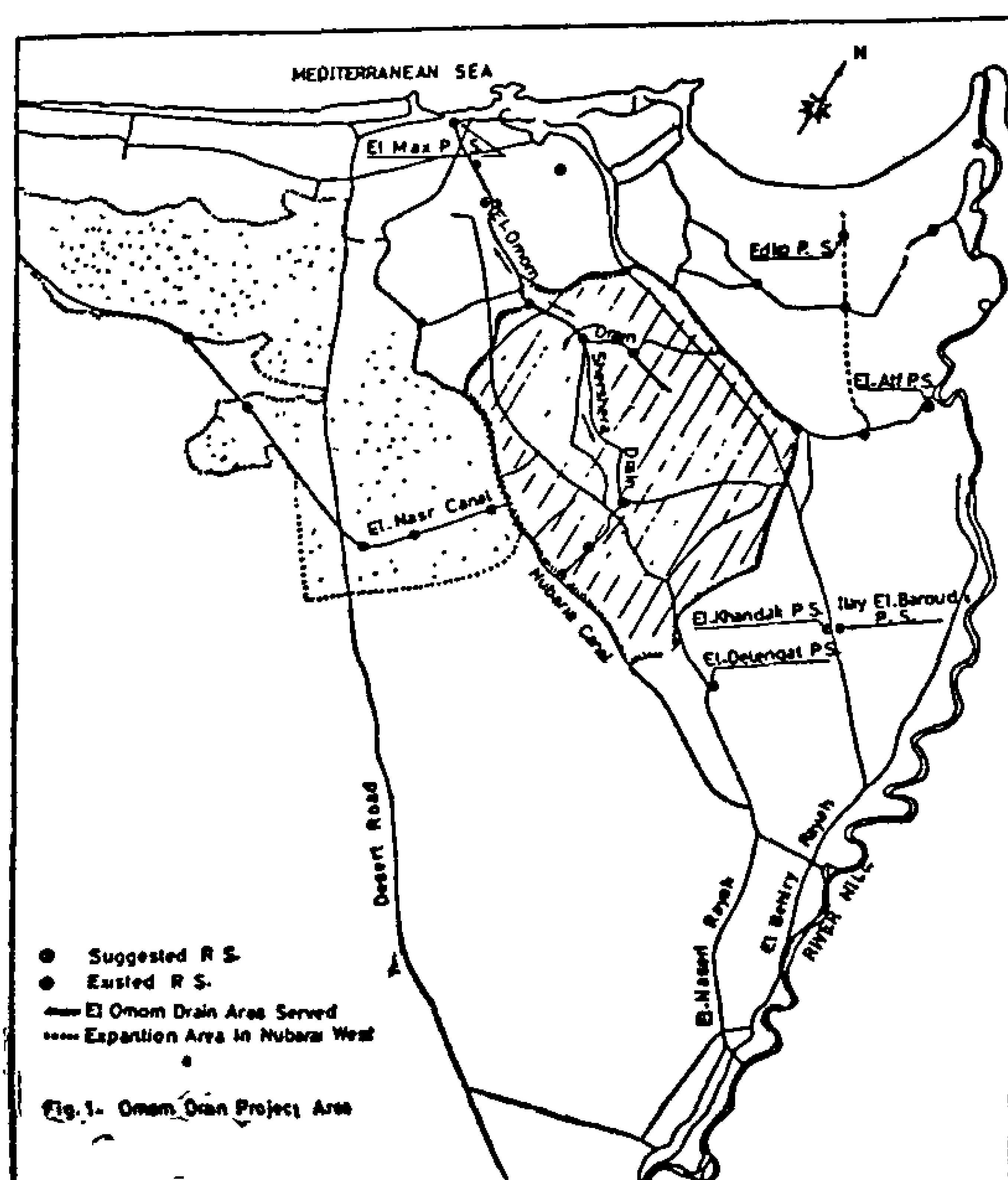


Fig.1- Omom Drain Project Area

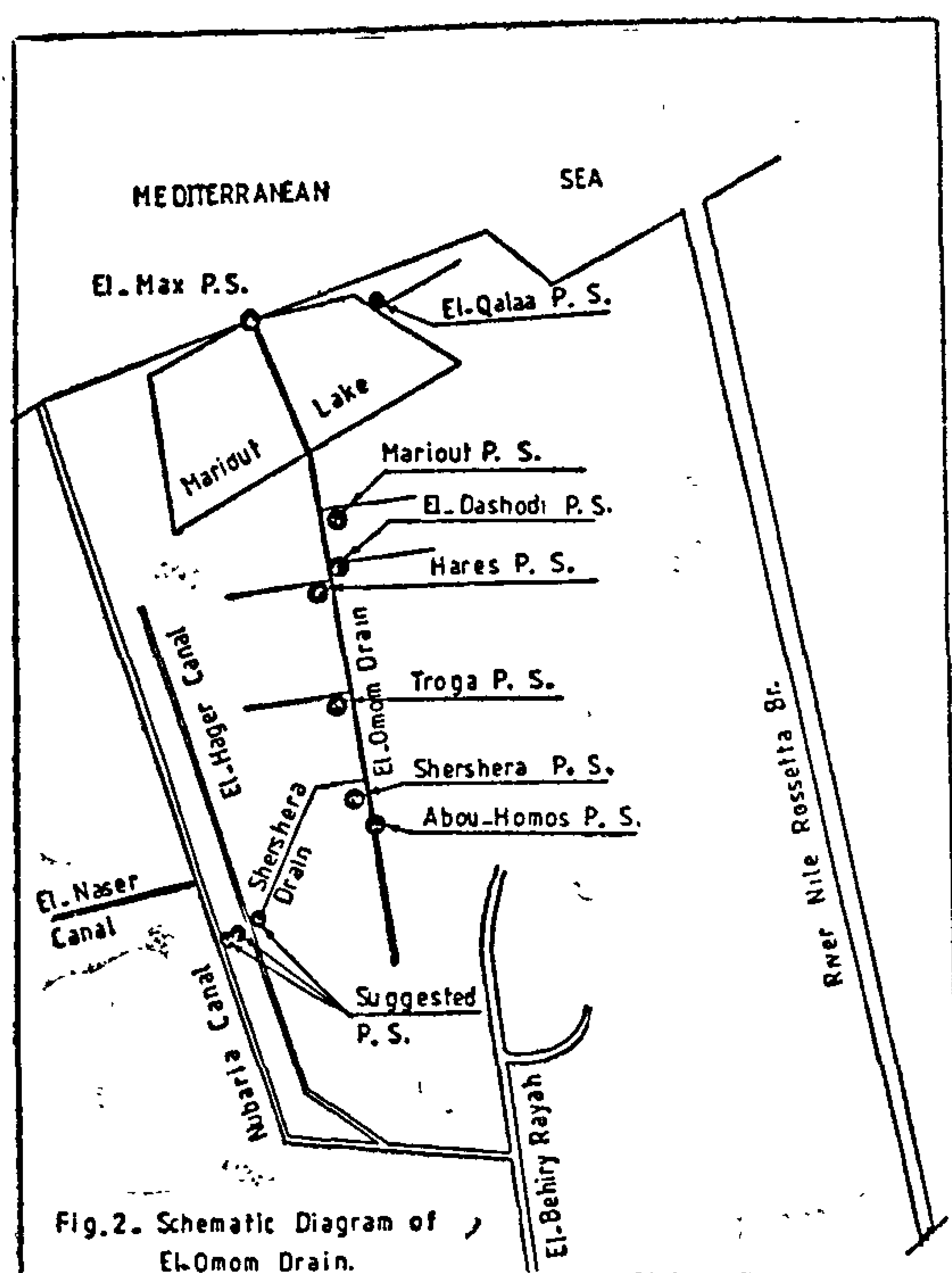


Fig.2. Schematic Diagram of El-Omom Drain.

For the reuse of El-Omom drainage water, it is proposed to redirect the water of Troga, Shershera and Abou-Homos pump stations to Nubaria canal. The expected amount of water to be used from these stations are 363.31, 472.80 and 159.88 million cubic meters respectively. The total discharge expected is 995.99 million cubic meters annually.

The expansion area west of Nubaria canal is expected to reash 425,000 feddans. The irrigation water requirements for this area is about 2.5 milliard cubic meters. Also another one milliard cubic meter is required for the municipal, industrial and navigation purposes. Therefore, a total of 3.5 millard cubic meters are required for the development of the area up to year 2000. The expected 995.99 milliard cubic meters from El-Omom drain project represent 28.46 percent of the total amount required for the area.

DATA COLLECTION AND ANALYSIS

In order to make assesment of the implication of the irrigation water management on the reuse of drainage water policy, it was necessary to investigate the entire West Delta region. The irrigated area of West Delta is about 1.2 million feddans. The sources for fresh water are Behera Rayah ,Naseri Rayah, El-Atf pump station and El-Rasheedia subsidary. They supply about 90 percent of the water needs of the area. The reused drainage water sources are Edko, Italy El-Baroud El-Khandak and El-Delengat irrigation -drainage pump stations. They constitute about 10 percent of the water needs of the area.

Table 1 (ref.1) summaries the water discharge used for irrigation purposes for West Delta from 1977 to 1984. The table clearly reflects the dependebility on the fresh water as the main source for irrigation water. This, in turn, indicates that any reduction in fresh water supply, as for irrigation water management, will have a sound impact on the availability of the drainage water for reused. Table 2 (ref. 2) presents the water demands for West Delta for the period 1977 -

IMPLICATION OF IRRIGATIONWATER MANAGEMENT ON RECLAMATION PROJECTS IN WESTERN DESERT OF EGYPT

By

A.S. El-Zaher[1], M.M. Salama[2]

INTRODUCTION

The irrigation and the drainage processes are interconnected which can not be separated. Each of them affected on and effected by the other. In the last decade, the Nile basin countries were suffering from drought. Up to now, Egypt was not effected by such drought due to the stored water in the Aswan High Dam reservoir. However, the volume of water decreased drasticly due to the over release to cover the annual demands for irrigation, power production, navigation, municipal and industrial requirements. Meanwhile, large quantities of drainage water are spilled into the sea. Therefore, the Ministry of Puplic Work and Water Resources in Egypt started several measures to save on water, as irrigation water management, reuse of drainage water after mixing with fresh water and increase the usage of ground water sources.

In aspect of reuse the drainage water, several projects are established to irrigate new lands for the horizontal expansion. One of these projects is the reuse of El-Omom drain water to irrigate new land. El-Omom drain located in Behera governorate spills annualy about 2.5 milliard cubic meters of drainage water to the sea through El-Max pump station. According to El-Omom drain project, it is estimated that about one milliard cubic meter of drinage water will be reused after mixing with Nubaria canal for the needs of the development of the new areas.

The objective of this work is to study the effect of the irrigation water management on the expected drainage water which is planned to be used from El-Omom drain for the reclamation projects at west Delta.

DESCRIPTION OF THE STUDY AREA

El-Omom drain project area is bounded be Nubaria canal to the west, Mahmoudia canal and Khiri drain to the south and Mariout lake to the north (see Fig. 1). El-Omom drain and its tributaries, which lies in this area, collect the drainage water and spill it to the Mediterranean sea through El-Max pump station. The main tributary drains are discharging their drainage water to El-Omom drain through Mariout, Hares, and Abou-Homos pump stations (see Fig. 2). El-Omom drain is one of the largest drains in Egypt which serves about 400,000 feddans west Delta. The project area is irrigated mainly from Behara Rayah and El-Hager canal.

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lines. Keeping in mind that the flow in these regulators is submerged most of the time, it was postulated that the line which passes through most of the point (the solid line) represents the submerged case and the other line (the dashed one) represents the free flow case

3.2 Calibration procedure

From the above mentioned analysis the calibration of hydraulic structures with sluices can follow the following steps.

1. The upstream water level and the gate opening are recorded and flow condition (free or submerged) is indicated.

2. The discharge is accurately measured using currentmeters and the discharge per unit width is determined.

3. Step (1) and (2) are repeated for a wide range of discharge.

4. $q/d_1 \sqrt{2gd_1}$ is plotted against d1/a on log-log paper which should plot as straight line. The least square method can be adopted to determine the best fit relation.

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2. Gunther Garbrecht, «Discharge computations at river control structures», Discussion, J. of Hyd. Div., ASCE, HY12, 1977, pp. 1481 1484.

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The procedure was to open the sluice gate a certain opening. The upstream overflow gate was used to control the discharge while the downstream flap gate was used to control the downstream water level The upstream depth «d_1», the gate opening «a» and the head over the weir «h» are recorded. For free flow, d_1/a range from 1.5 to 8.75 and for submerged flow the range is from about 2.0 to about 8.0. The data are shown in tables (1) and (2).

TABLE 1. Experimental data of the free flow

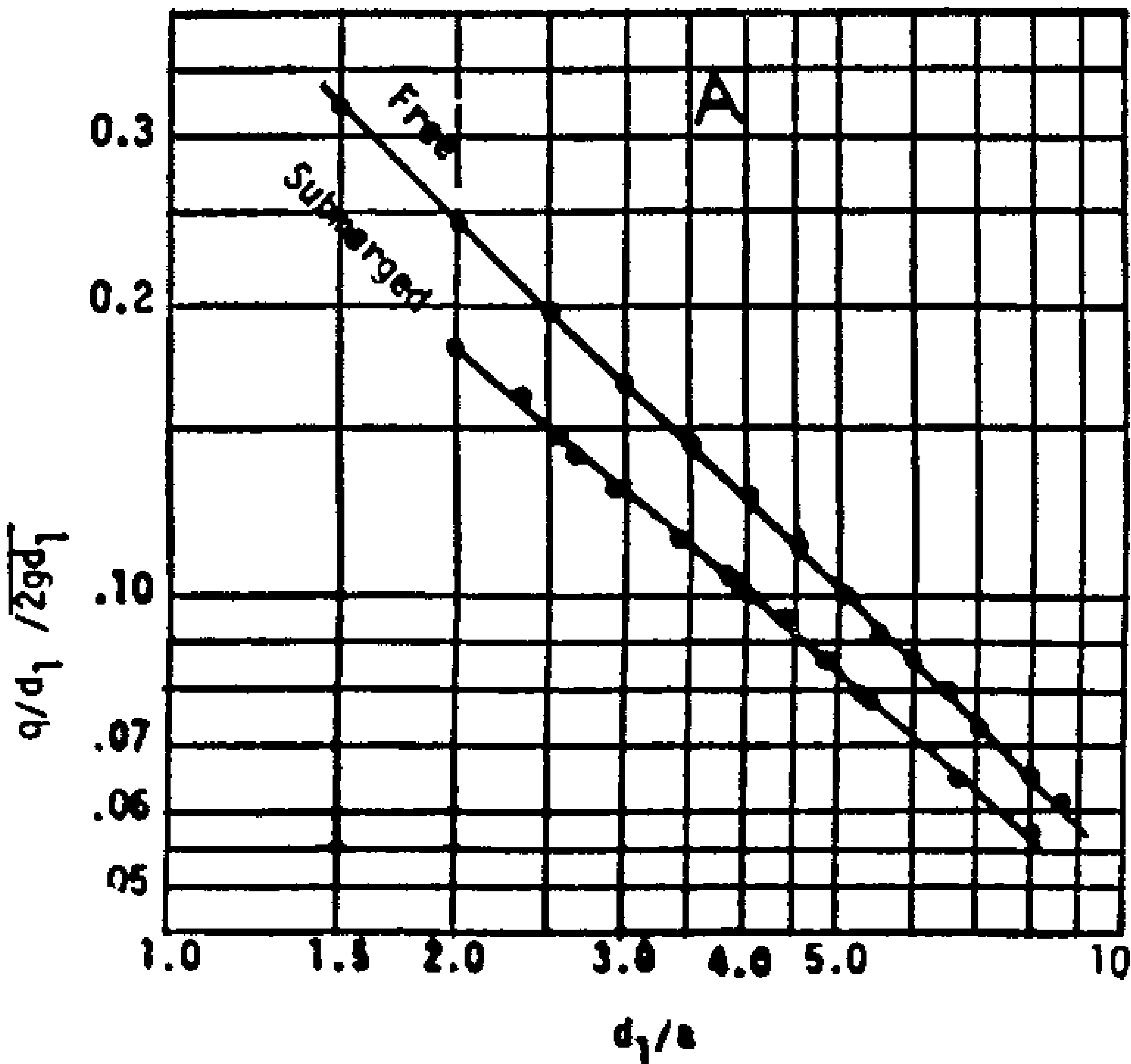
Gate opening (a) "cm"	Upstream depth (d_1) (cm)	Unit Width Discharge (q) m^3/sec./m
8.00	12.00	0.0602
	16.00	0.0681
	20.00	0.0780
	24.00	0.0850
	28.00	0.0960
	32.00	0.1000
	40.00	0.1139
	48.00	0.1277
	56.00	0.1381
	64.00	0.1488
	70.00	0.1600
10.00	15.00	0.0838
	20.00	0.0951
	25.00	0.1100
	30.00	0.1197
	35.00	0.1300
	40.00	0.1406
	45.00	0.1500
	50.00	0.1600
	55.00	0.1670
	60.00	0.1750
	65.00	0.1850
	70.00	0.1910
12,00	18.00	0.1083
	24.00	0.1268
	30.00	0.1440
	36.00	0.1600
	42.00	0.1750
15.00	30.00	0.1840
	45.00	0.2275
	60.00	0.2669
18.00	36.00	0.2338
	54.00	0.2951

TABLE 2. Experimental data of the submerged flow

Gate opening (a) "cm"	Upstream depth (d_1) (cm)	Unit Width Discharge (q) m^3/sec./m
8.00	20.17	0.0586
	42.22	0.0954
	64.28	0.1300
10.00	28.94	0.0886
	48.31	0.1270
	66.46	0.1571
12.00	31.70	0.1090
	47.22	0.1470
	64.51	0.1797
15.00	35.19	0.1500
	51.50	0.1880
	66.00	0.2250
18.00	35.78	0.1714
	46.51	0.2100
	69.75	0.2700

3.1.2 Analysis of the results

Equations (7) and (13) are used to plot $q/d_1\sqrt{2gd_1}$ against d_1/a on a log-log paper. This is depicted in figure (4). As shown in the figure, the correlation is very good. For the the free flow, the correlation coefficient equals -0.9997 and equals -0.9975 for submerged flow.



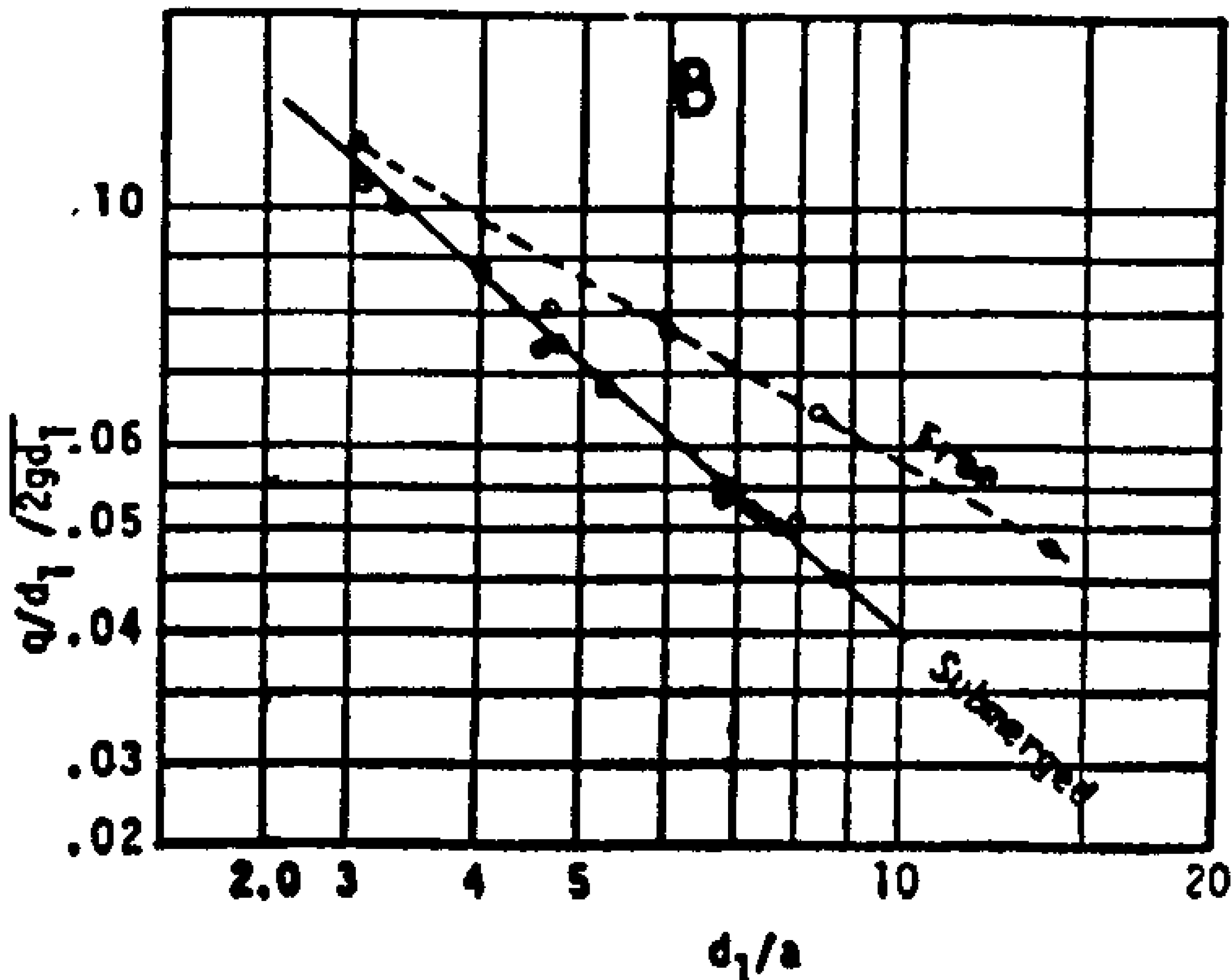


Figure 4: Plot of $q/d_1\sqrt{2gd_1}$ for free and submerged flow.

A - Experimental data

B - Tawfiki canal data.

Also, field data for the Tawfiki head regulator was plotted and shown in figure (5). There was no indication of wheather the flow was free or submerged. However. the plot showed two distinct

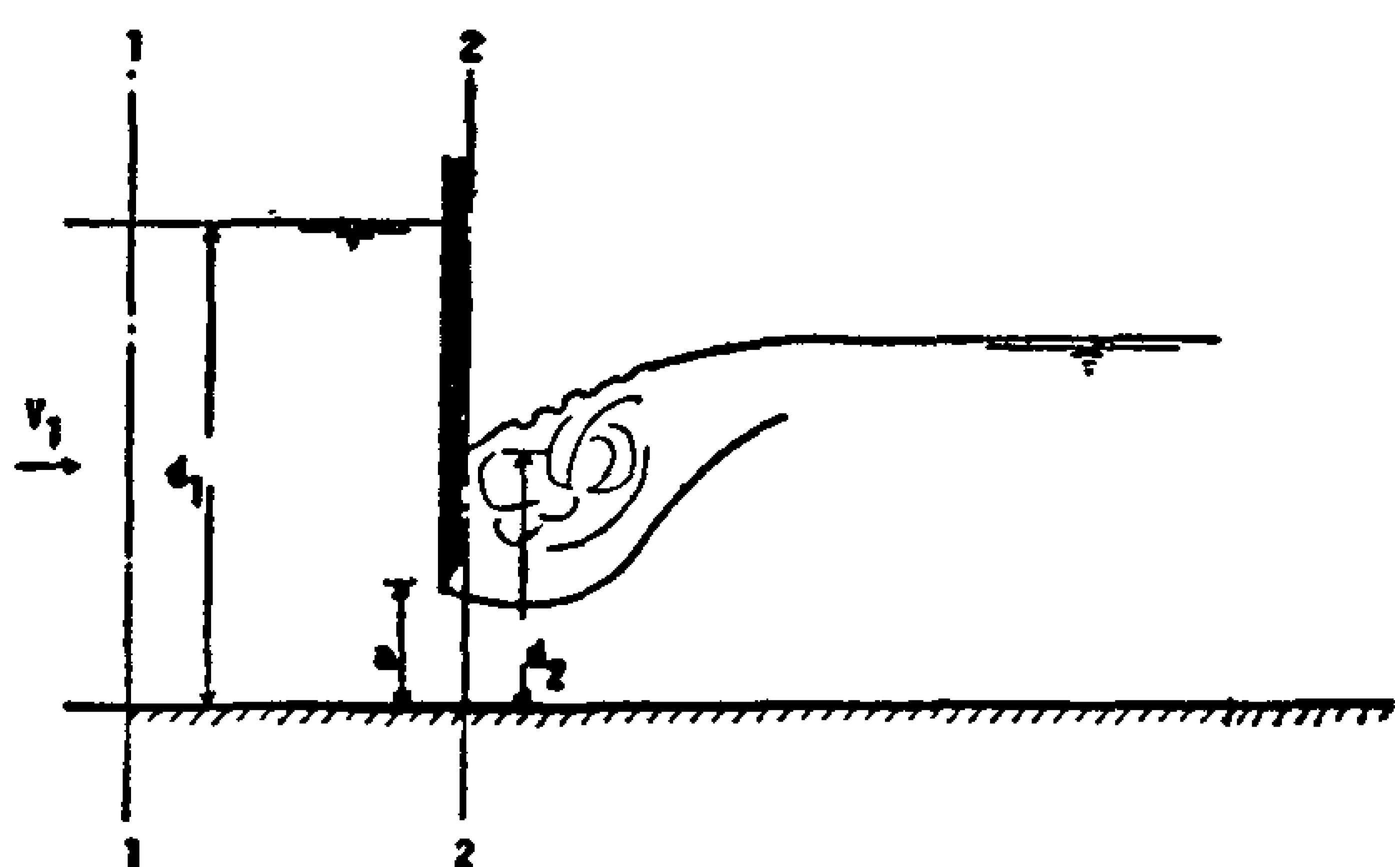


Fig. (2) Submerged flow under sluice gate

Assuming hydrostatic pressure distribution at section 1-1 and section 2-2 then :

$$F_x = \frac{\gamma d_1^2}{2} - \frac{\gamma d_2^2}{2} \qquad (11)$$

Substituting F_x from equation (11) in equation (10) and using $V = q/d$ after rearrangeng

$$\frac{q^2}{2g\, d_1^3} [2\beta_2 \frac{1}{(\frac{d_2}{d_1})} - 2\beta_1] = \frac{1}{2} [1 - (\frac{d_2}{d_1})^2]$$

(12)

The dimensionless quantity d_2/d_1 from equation (9) can be substituted in equation (12) to yield an equation of the form :

$$\frac{q^2}{2g\, d_1^3} = f_2 \left(\frac{d_1}{a}\right)$$

3. Calibration of flow regulating structures.

Based on theoretical analysis in section 2-2, it is possible to calibrate any irrigation structure with a sluice gate by means of equation (7) for free flow and equation (13) for submerged flow. Although the dimensionless variables in the two cases are the same(the functional relationship is different. The calibration procedure require the knowledge of the discharge «q», the upstream water depth d_1 , and the gate opening «a». Once the calibration curve is established, the water discharge can be determined provided that d_1 and a are known. Experimental and field data were used to verify the theoretical analysis presented in this work.

3.1 Experiment and experimental data analysis

The facilities in the Hydraulics & Sediment Research Institute in Delta Barrage area in Egypt were used to carry out the test program.

3.1.1 Experiment set-up and procedure

The test set-up is shown in figure (3). A one meter width and about 20 meters long concrete channel has been provided by a rectangular weir at the upstream end to measure the discharge and an adjustible flap gate. A sluice gate has been installed in the middle of the channel which can be opened or closed by screwed rod and wheel. The discharge has been controlled by an overflow gate.

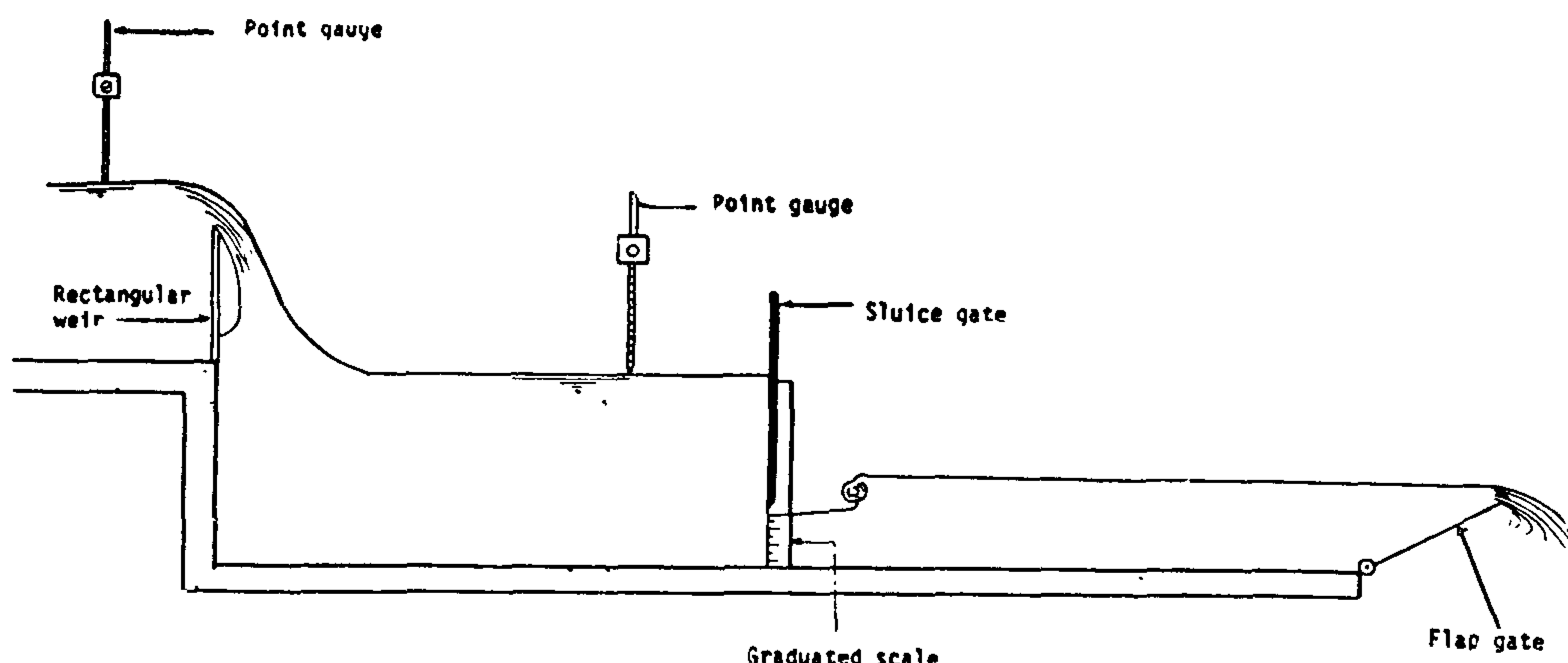


Fig. (3) Schematic diagram of the experimental set-up

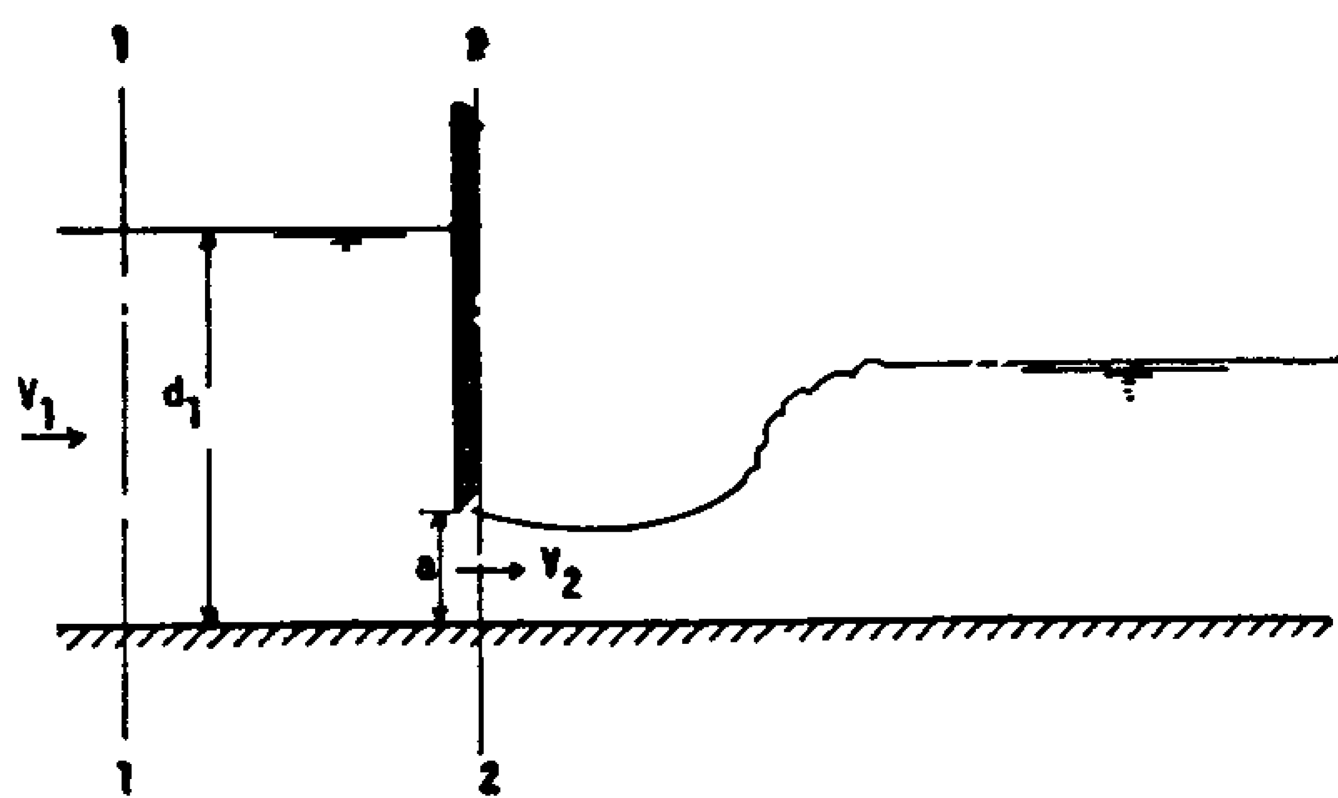


Fig. (1) Free flow under sluice gate

The discharge per unit width is q. substituting.

$$V_1 = \frac{q}{d_1}, \text{ and } V_2 = \frac{q}{a}$$

into equation (1) and dividing by d_1 yields.

$$\frac{\alpha_1 q^2}{2g\, d_1^3} + 1 = \frac{\alpha_2 q^2}{2g\, a^2 d_1} + \frac{a}{d_1} + \frac{h_{L1-2}}{d_1}$$

Then :

$$\frac{q^2}{2g\, d_1^3}\left(\alpha_1 - \alpha_2 \left[\frac{d_1}{a}\right]^2\right) = \frac{1}{\left(\frac{d_1}{a}\right)} - 1 + \frac{h_{L1-2}}{d_1} \quad (2)$$

The head loss can be expressed as a function of $V_2^2/2g$ as in the case of the head loss due to sudden contraction. In this case :

$$h_L = K\frac{V_2^2}{2g} = K\frac{q^2}{2g\, a^2} \quad (3)$$

$$\text{where } K = f_1 \left(\frac{a}{d_1}\right)^2 \quad (4)$$

From (3) and (4) :

$$H_{L1-2} = f_1 \left(\frac{a}{d_1}\right)^2 \frac{q^2}{2g\, d_1^2} \left(\frac{d_1}{a}\right)^2 \quad (5)$$

Substituting h_{L1-2} from equation (5) into equation (2) :

$$\frac{q^2}{2g\, d_1^3}\left[\alpha_1 - \alpha_2 \left(\frac{d_1}{a}\right)^2 - f_1 \left(\frac{a}{d_1}\right)^2 \left(\frac{d_1}{a}\right)^2\right] = \frac{1}{\left(\frac{d_1}{a}\right)} - 1 \quad (6)$$

Equation (6) represents the general equation of free flow under sluice gate. Equation (6) can be written as :

$$\frac{q^2}{2g\, d_1^3} = f_2 \left(\frac{d_1}{a}\right) \quad (7)$$

2.2 Submerged Flow

Applying the energy equation between sections 1-1 and 2-2 in figure (2) one gets :

$$\alpha'_1 \frac{V_1^2}{2g} + d_1 = \alpha'_2 \frac{V_2^2}{2g} + d_2 + h_{L1-2} \quad (8)$$

Using $V_1 = q/d_1$, $V_2 = q/a$ and rearranging :

$$\alpha'_1 \frac{q^2}{2g\, d_1^3} + 1 = \alpha'_2 \frac{q^2}{2g\, a^2 d_1} + \frac{d_2}{d_1} + \frac{h_{L1-2}}{d_1}$$

Following the same procedure as the free flow, then :

$$\frac{d_2}{d_1} = 1 + \frac{q^2}{2g\, d_1^3}\left[\alpha'_1 - \alpha'_2 \left(\frac{d_1}{a}\right)^2 - f_1 \left(\frac{a}{d_1}\right)^2 \times \left(\frac{d_1}{a}\right)^2\right]$$

Next, the momentum equation is applied between sections 1-1 and 2-2 as follows

$$F_x = \rho q (\beta_2 V_2 - \beta_1 V_1) \quad (10)$$

where ρ is the desinty of water, β_1 and β_2 are the momentum correction factors for section 1-1 and 2-2, respectively, F_x is the resultant of the horizontal forces acting on the free body between the two sections per unit width.

ANALYSIS OF FLOW UNDER SLUICE GATES AND NEW CALIBRATION PROCEDURE OF THE FLOW REGULATING STRUCTURES

Dr. Mohamed R. Abdel - Bary

1. INTRODUCTION

Calibration of flow regulating structures in general and those with sluice gates in particular is of a great importance in the process of water distribution in irrigation systems. A great deal of time and effort can be saved when it is desired to estimate the discharge through sluiced structures, by using the calibration curve rather than by measuring the discharge.

In the presence of calibration curve, the discharge can be determined by measuring water levels and gate opening. By means of modern techniques, it is possible to monitor and control the flow through great number of these structures in pratically no time if the calibration curves for them are available however, time and effort saving should not be at the cost of accuracy. There are two main reasons for inaccuracy of calibration curves. These are :

i. Improper choice of the variables, so that the correlation between the independent and the dependent variables is not good enough.

ii. One or more of the independent variables can not accurately be measured. For example, most of the published research for the submerged flow under sluice gates used the flow depth just downstream the gate as an independent variable (1,2,3). Measuring this depth with some degree of accuracy could probably be accomplished in the laboratory. However, in the field, the water surface downstream sluice gates becomes very rough and foamy and water level fluctuates due to the highly turbulent flow. With this flow condition, accurate measurement of flow depth becomes questionable.

In this paper a trial is made to avoid the effect of the above mentioned reasons for the inaccuracy of the calibration curves.

Theoretical Analysis

2.1. Free Flow

In the flow in figure (1), the energy equation can be applied between section 1-1 (far enough upstream the sluice gate) and section 2-2 (just downstream the sluice gate) as :

$$\frac{\alpha_1 V_1^2}{2g} + d_1 = \frac{\alpha_2 V_2^2}{2g} + a + h_{L1-2} \qquad (1)$$

where :

V_1 and V_2 are the average velocities at sections 1 and 2 respectively,

d_1 is the flow depth at section (1),

a is the gate opening,

α_1 and α_2 are the energy correction factors, and h_{L1-2} is the loss between sectons (1) and (2).

take its actual meaning related to the whole universe.

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the economical and the new structural form and a technological building to come to the light without keeping the character.

Compared to a situation when a new building is planned to be built in a site not very far from the Giza Pyramids as a historical place where the Egyptians utilized their Technology of the past, many question are raised. Should the designer of the new site keep the same pyramidical form? Should be use the same stones ? Should he reflect the same structure or speak the same old technological language? Should be follow the old philosophy or create his own ? technology is the language of the age. Some may say that there is too much technology already, but anyone who tries to solve a human problem is likely to wish for more new technology. The existing technology today, alone, is capable of solving the whole spectrum of human and urban problems. On the other hand, some futurists have called for the development of new technological solutions to ensure the long range control of our environment. Here, technology does not act against nature as some may claim, but it improves environment and proves itself against nature. It adds new dimensions. There dimensions will be the heritage of tomorrow. Technology exceeds limits, whatever man does to improve his physical capabilities, he reaches, or almost to his limits. The car is an example, comparing the speed of a man and a car and promises of evolution.

Architecture is a challenge because the designer must look out to prove himself not to look in himself. He must widen his scope of knowledge and his sources of information, to bear in his mind the potentialities of the time. The reason is whatever his treasures and heritage is rich, it is still a limited aspect compared to the promises of technology and the future.

The challenges mean that the architect's aim to maintain his tradition could not be achieved by applying the old ones or reinterpreting old principles in the light of changing conditions, but by re-evaluating the very principles themselves. This means that the designer must use history for the sake of the future not against it. That means a return to the basics: architecture as having a shelter to stand strong against nature. Now, man can stand against nature and future aas well, equipped with the new effective weapon: technology. Man must be prepared for the extreme environmental damage that potentially might occur. Man must plan not to give himself to nature any more. Architecturally, this means a new language. The existing language is different from place to place due to its natural variables (climate - geography, etc...) and different from time to time due to man constraints and barriers, walls of stone and radical discrimination.

As man need energy as the force to penetrate the gravity of the land, this force is needed to be liberated out of the word "local". It is a potential in the fresh minds and faithful souls. It is being displayed in any creative works, in art or in architecture. The word "local" must

place, "my place", it has meant something now it means something else. With the development of communications, the placame nearer and closer. New meanings appear of "here and there", «us and them». When man sings we, he means «we are the world». One community that is friendly and familiar, and what's foreign for the contemporary man is the outer space and planets, where he feels foreigner and stranger.

In such a time, when some people claim that their society or country has a local architecture, it is a false and old fashion expression. Hence, he's not capable to feel the spirit of the time and speak its language. He, who claims, aims to understand and comprehend the past, while others' interest is to understand and prepare for the future.

Local architecture is a challenge to the architect of the future, to prove himself not to fell himself. To prove himself as an identity of a place and a personality of a time. To prove his participation in the continuous chain of inventions, creativity and achievements, not to feel himself by repeating the tempo of his historical victories, in the field of fight or, of architecture. We can forecast the trends which may be ahead of us for the future by observing how we utilize our past in the present time. Architecture is a challenge because architect has to stand against himself not with himself. To criticize his heritage, his architectural treasures without prejudice to a definite attitude of thinking or method of designing forms, spaces and ornamentation. In brief, not to repeat architecture thoughtlessly, claiming that it is a successful, well experienced local character and architecture.

LANGUAGE AND ALPHABETS

One may ask whether there is a technological language, and whether it is strange and foreign to us. Whether there is a language or vocabulary for the local architecture based upon an architectural basis. In other words, is there a unique alphabet to compose and express the local lenses and to achieve a local architectural language. If there is one, then we can discuss the visual aspect of the local architecture and criticize it. If there is not, then nothing is called local architecture, nothing is called Egyptian local architecture.



Fig.11

Should we repeat the style or should every future do it, while it will have its own philosophy and reason to prove ahievement ? For example, Semiramis Inter-continental, in Cairo is a proof that is the old building dismantled to leave

Our time is a transitional period. Since it started, our mental life has been without equilibrium. Thinking and feeling are separated. The equilibrium of an epoch could be determined according to the degree to which its methods of thinking and feeling coincide. When these methods move apart, there is no possibility of a culture or a tradition. Not any thing that has the value of being old should be hisorical and give character to the place and its surroundings, to be preserved and its style to be kept for the new buildings.

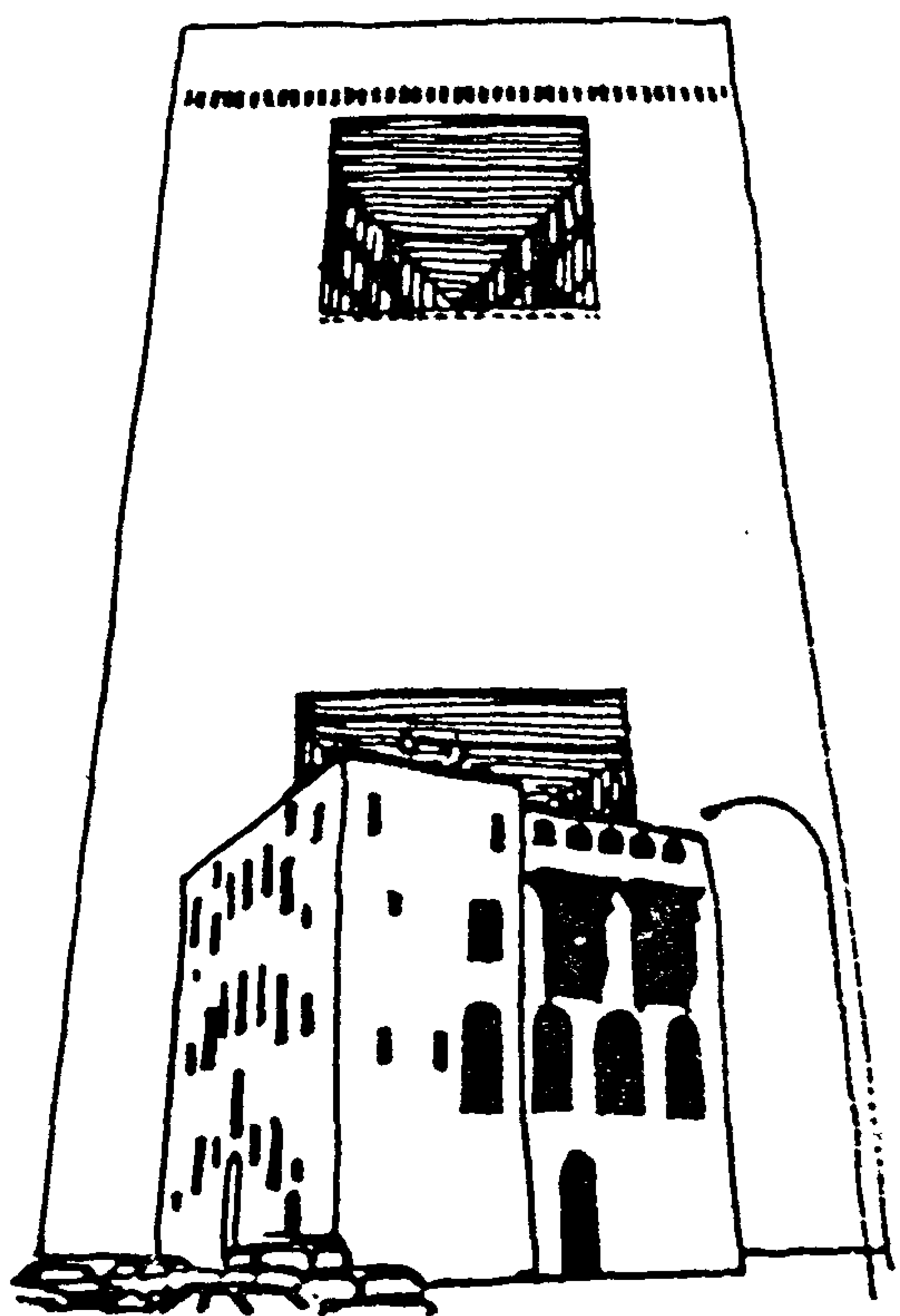


Fig. 10

Does the aspect or meaning of any architectural form give character to the place or does the place influence the character of the buildings? Meanings of buildings and places are subject to change with time. Abdin palace is an example. It was a symbol of power in the past, then it was transformed into a museum. Historical buildings are th eones that have a certain value and influence for a long time and still have that influence. This means that the main factor is the public's betiefs and thoughts. Also, historical aspect which has a hidden value of technique, philosophy, human senses and new technology which people cannot match as we do right now. The historical building may be an imortant component in the overall image of the place, it may be the major landmark of the area. In this case, is the place a neutral abstract aspect, never influence the character of the building ? Or does the building influence the place? The building could influence the character of its surroundings to limited extent in a certain time, then the influence disappears, When the building still means designers and users, it means that man can influence the character of the building, orients it without limits by his power of imagination and creativity.

NEW MEANING OF LOCAL ARCHITECTURE

Searching for the identity

God has created the Universe not to practice a local architecture but, to exceed that limitation towards understanding life, its secrets, symbols and logic. Any wall or barrier is a man made; between two races, two religions, two economic systems or even two parts of one society. The meaning of society is being transformed. Now, the phenomenon is the overlapping of societies. When man called a

chnological message is happening may be slowly and partially but it happens.

When man first landed on the moon, the event was transferred all over the world. It was celebrated by all nations. That symbolized the degree of unity between people on earth regardless their beliefs. Even sports and games have exceeded the limits of the nationality, and the stars of of different kinds of sports hav efans all over the world. The world is going to speak a similar language in spite of their different tongues and colors. Coka Cola is an example.

Beliefs in the modern society are changing continually, replaced, discarded, always in favour of newer and better ones, in the public's common sense. Demands of the people changing extension of ambition/building may occur to growth or change of moods. Architects must give up the idea of being the intellectual elite of society : imagining, designing for their own satisfaction : but for the public's. They must respond to the change in people, in their culture and their dreams.

Architecture is the missing link between man and balance. Man's aspiration is to live in harmony with nature, but how can he achieve that in a very sophisticated era ? Archtecture can simplify the sophistication of methods, whose task is to harmonize man with man-made things. Now, these things are extended to cover all objects of life and environment. Man can design with quantitive elements the phenomenal senses of architecture, forms and spaces and all relationships of the urban environment. The modern society deals with facts, but some people still behave in attitudes that had been inherited from old ages, which no longer seem operating within the context of rapidly changing technology.

Changing as a message is transferred through different kinds of people/behavior, due to different places and different times of different layers of the same society; a country or globe. This transfer of message is getting faster due to the development of communications. The day will soon come when there will be no passport of language any more.

A DEFENSIVE WALL INSIDE

The City of Tomorrow

In most old towns and cities, there was a defensive wall for security reasons. It was build with the available materials of the place and the available techniques. The cily has grown and extended outside the city's walls. But the walls still exist inspite of the denial of the reasons for its existence. Now these walls are considered a burden on the planners of the cities. Many societies ignored these walls mantled others still keep it as it is and as heritage and gradually they were discontinually support it by restoration works, preservation and conservation.

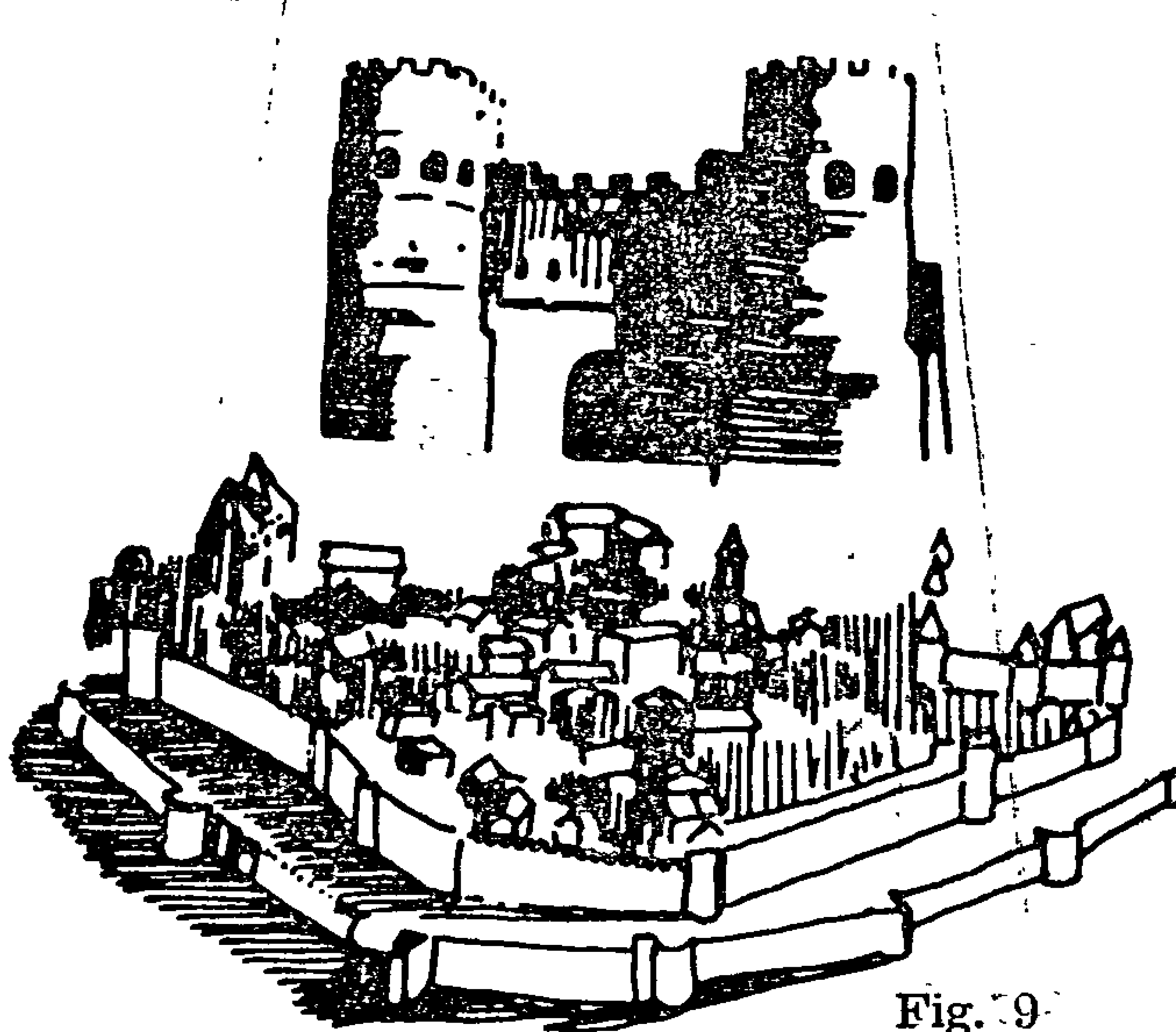


Fig. 9

They claim that this wall is a heritage and that it contributes in making the overall image of the city, and so the character of the place. The Old Cairo is an example. This defensive wall, is an example chosen out of many architectural elements, that are considered the major components of character. invaluable and intentionally imposed, introducing a static society, that we hope to be dynamic and revolutionary.

SPEED OF LIFE

Sophistication of Modern Society

"The recent qualitative changes in the relation of technology to science and in technology's aims, is above all associated with the astounding developments in electronics science and technology have leapfrogged past one another through recorded history, now one was in the lead, now the other. Anyone seeking a causal relation was just as likely to find technology the cause and science the effect as th eother way around : gunnery led to ballistics, the steam engine to thermodynamics, pawered flight to aerodynamics".

Progress of architecture as science is slower than the other branches of knowledge. Building as experiments of architecture take a longer duration to prove its validity, may be a generation or more. The experimental tools are the visual aspects of forms, spaces and the combinanations of them. These aspects could be studied, classified, categorized aiming to compose a new language with new alphabets. These alphabets are transmitted from one place to another, in different degrees, which depend on the available communication methods. Speed of transforming the visual aspect, meanings and messages depends on some factor influencing it: the people and their ideas. People of the place and their orientation, ideas behind the political and economical systems.

In a slow society, its speed depends on the people, the political system and the economics. While in the fast society, the political system acts as a catalyst, that does not affect it either negatively or positively. In the very fast society, its speed depends on people and freedom of the system, the standard of life and economics. The speed and the rate of change are different and changeble according to many different forces, while some architects still call for architectural statical facts.

Some define local architecture as the architecture for people : as a simlpe truth, neglecting the change that happened to the modern man and the tremendous gifts offered by technology. Modern studies state that humanity could be reached architecturally throught many traits, putting into consideration the transformation in meanings even in time and place. For a long time it was agreed that moving in place is a horizontal movement, but nowadays man can travel from earth to other planets. Also moving in history through studying it sequentialy is a vertical movement but nowadays man can take a tour in one place and live in all times of history, past and future. Disney land is a clear example.

The current rhythm in New York was not the same, years ago. In Cairo, it will not be like this after decades. It all depends on the applied technology and its penetration in the society. Fifty years ago, the political map of earth was different. Many wars were declared and many social changes resulted, but the people who made this history are not living with us now. The Berlin wall is an example.

A hundred years ago, there were no T.V., no airplanes, no sky scrapers or speedy cars. Everything has changed, but character. Change, in the future, will be fast as well. Even the image of tomorrow is changing : as reflection to the evolution of new philosophies. People can change the image of what will come after, as they in some societies, change and rewrite the history, due to certain orientation of an idelogy or the dishonesty of governors. Even wars, in a certain point of view, change the visual aspect and behavior of the people. We see mirage 2000 or F.16, the most sophisticated technology of century, in a sky belonging to a poor, underdeveloped country. That means that the transfer of the te-

was united in essence and spirit. That differentiation was in the external, and was due to climate variables, available building materials and techniques, different shapes, proportions, kinds of detailing, ornamentation, arches, mashrabias, etc... In spite of these diversities, the whole represents a personality and identity of a religion.

Style and fashion are smiliar in being changeable with time. In case of the style the evolution is slower than the creativity of the people or the invention of new methods. The fashion or style is defined according to the composition of architectural elements, the synthesis of how the parts come together with priorities and emphasis of definite elements. Sometimes, people maximize historical elements and utilize heritage as magnet for attraction to support commercial purposes, hence, it is a fashion. This fashion is speedy. They are being successful when evolved due to temporal effects. They disappear in short durations. They may appear and be dispersed to attract attention. It is intuitive works to satisfy artists of special moods or just evolved for change, the new for its own sake. Sometimes it appears without explicit logic or reason, but it gets acceptance and fame by the public.

The character for a certain environment is the reflection of the place and its context with all its dimensions It is the identity and flavor of the place that is defined by the association of appearance and physical features, also by observed activities and functions, meanings and symbols. The association of these various impact, social, religious, cultural and standard or quality of life identify each society with a special distinctive character. These impacts are no argument, subject to change from time to time.

Is the product of these interweaving impacts constant or is it variable ? If it had to be constant, never changing, the question might be, why is it constant or consistent in keeping on with a definite detail of an architectural element, a window, an arch or even a form? The other part of the dilemma, if it is variable, if it is subject to change, the question is what are the laws behind interpreting it architecturally? whether there are any laws at all. Many phenomena give the impression that it is a variable, changing factor. It is obvious that there is not a compelling necessity to keep on with the character, if we consider these definite architectural elements as character. Then, innovation no longer seems possible or even desirable. This means a setback in the human endeavour towards development and evolution.

Character does not mean repeating or imitating the past or even an explicit translation of its architecture, simplifying its components, but originating its philosophies and spirit by studying carefully its characteristics and letting it react spontaneously in the sophisticated minds that comprehend the achievements of the twentieth century.

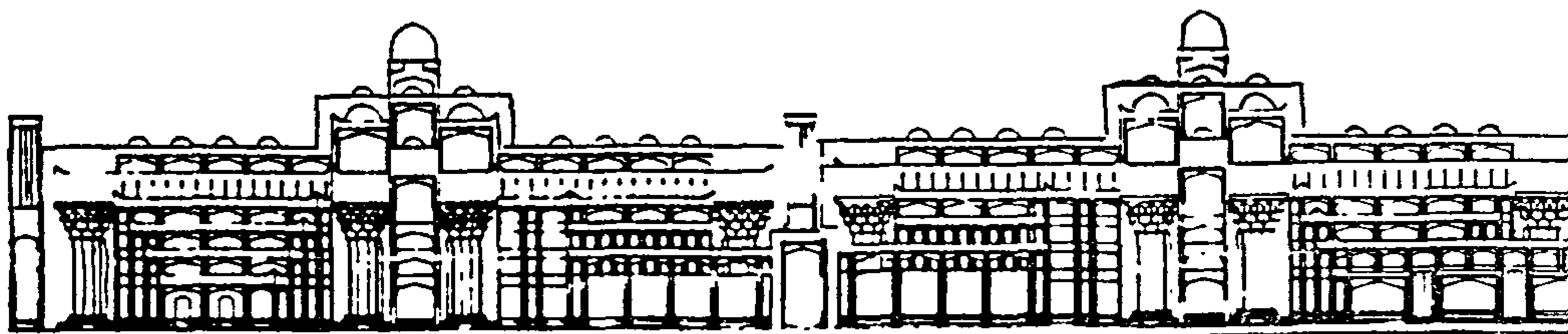


Fig. 8.

stic ? This problem was made by the critiques and architects themselves because most theorists and academic architects are fond of classification and categorization of architectural works and ideas. This made architects exaggerate in order to identify a certain character to their building.

Post-modernism is an exampe, In the last decade, many immature architectural works were created under the umbrella of the immature post-modern ideals and concepts. They followed the traces of pioneers without recognizing whether it is a style, a character, a new attiude a fashion or just a genius whim. Post-modernism is another step towards unity of human race. It is a rejoice that man began to realize this fact. A new event in mans's conscious participation in the historical and cosmic process.

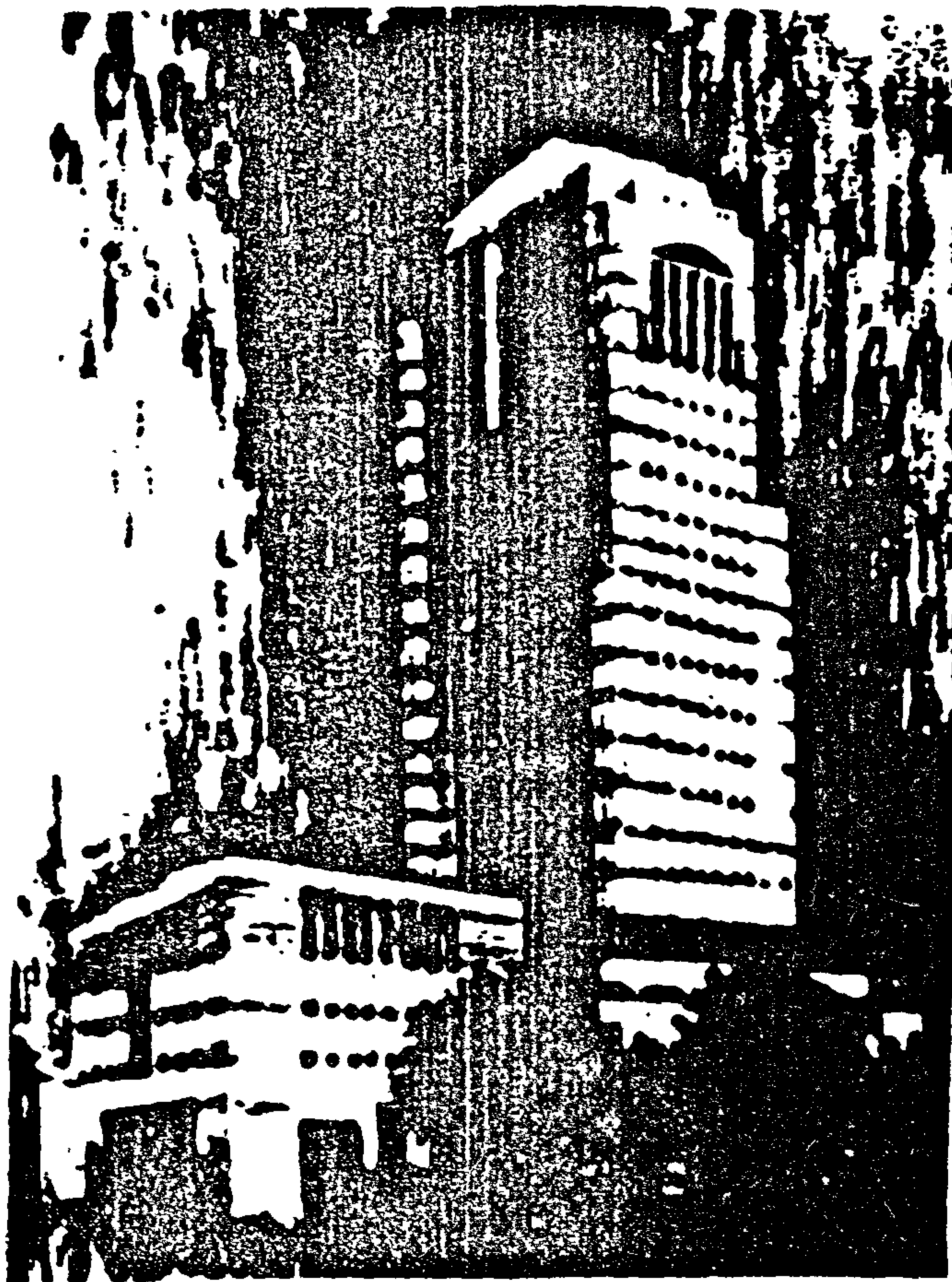


Fig. 7.

In Modernism, architects have thought for some time that they have reached permanent values, demands and goals. Yet after years of experiments throughout buildings they have discovered that they do not stand on solid ground or any basis of values, simply because they had no connections with the past, its heritage, creativity and humanity. Thus modern architecture has produced nowhere architecture for nowhere man; architecture without spirit, without character.

There are two aspects in dealing with character : as a style or as a fashion. Style as a formalistic description of the times of architecture of clear and definite configurations that extended through long periods of time. It might be a reflection or a reaction to a cultural or ideological concept of a definite era or place. It might be a way of representing the public's behavior and ideas, interpreting them into architectural elements. Style as a manner of expressing ideas is order, proportions and details.

Some may say, that style has been named style when it stops evoluton through growth, interaction or adaptation to the changing environment around, when it becomes a frozen, inflexible dogma of certain characteristics through lines, relationships between elements in certain proportions. Style declines, when the architectural creativity becomes limited only in borrowing formalistic and superficial elements without examining its values and meanings. Style implies certain features of rules and regulations of an epoch, its criteria which can be handled by architects, ovaluated and repeated when needed. Style could be a fashion when it has the ability to be repeated in different times and places.

In the times of the Islamic tide, there was what is called Islamic architecture. It was applied in different parts of the world, in Morroco, Egypt and China. That architecture was different in details but



Fig. 5.

Abdin palace (1860 A.D.) was an abrupt transformation, from the religious aspect of government and governor to a new unfamiliar royal regime. That was interpreted immediately in the urban tissue of the city and its structure.A frog jump from the citadel on the top of the Mokattam hill as a symbol of supremacy and surveillance to a contradictory, imported image of the governor palace, in a new location amongst the people, outside the old city. The represented is a new magnet and generator to a new era, a new planned city for the future and a new way of life.

Dealing with the character is a dilemma that faces the architect when he is requested to design a new development, in a site that influenced by a historical building. Many questions must be answered first. How to deal with the old character ? What happens when a historical place collapses due to the factor of time ? Do we have to reconstruct it with the same old character, as the school of revivalism are calling for? with the same materials and the same technology of the past, whatever it was. Or, utilize the contemporary ones that facilitate more speed, less time and cost with its values and aesthetics. Do we have to rebuild it according to the old codes and regulations that have already changed ?

The answer is certainly not to copy or imitate, because designing and building with the same old character or style

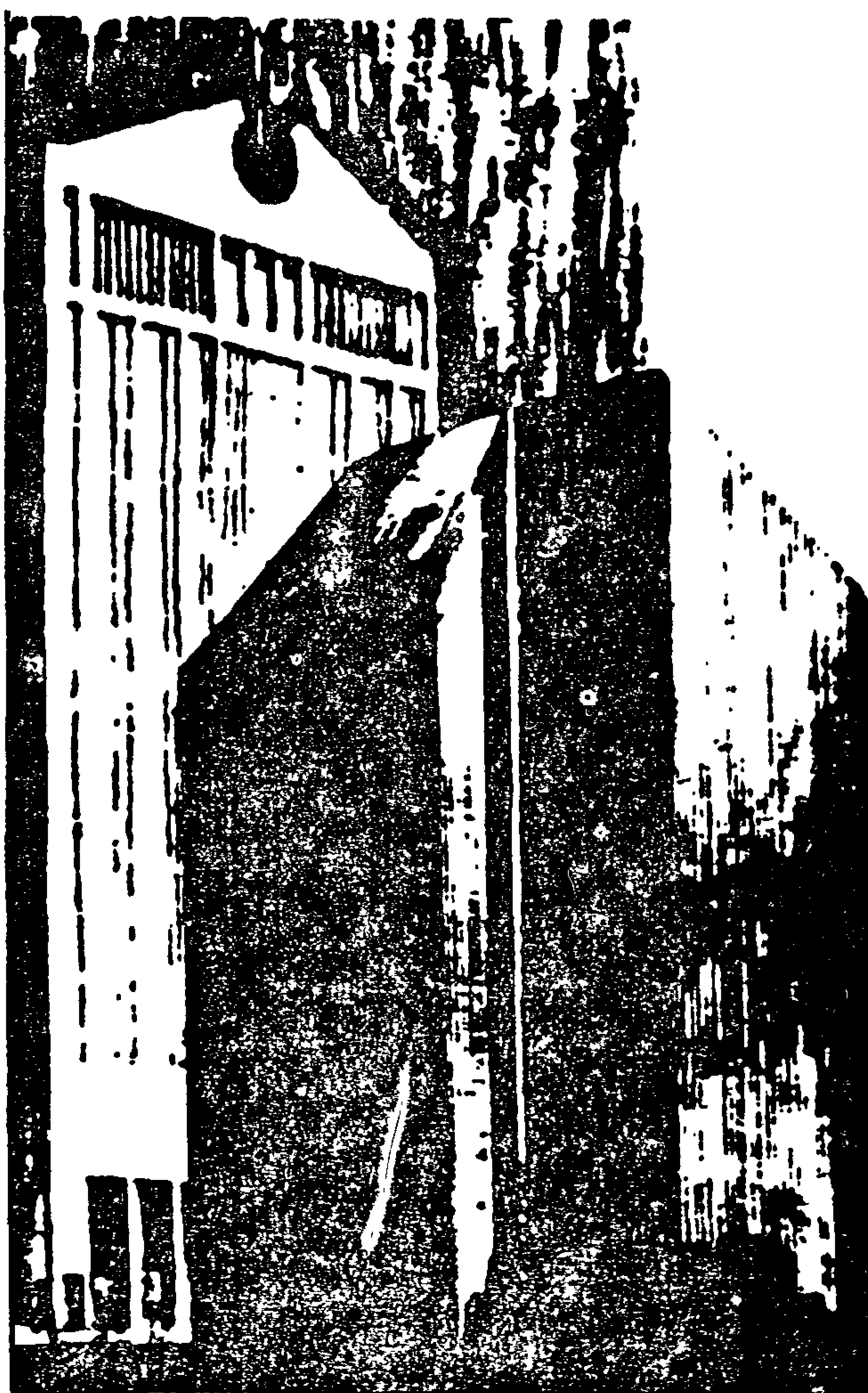


Fig. 6.

means denying all the achievements and efforts of the ancestors. But the question is still, what do we have to preserve? What is worth saving? What is the valuable architectural building? Is it the historical, just for being old, or humani-



Fig. 2.

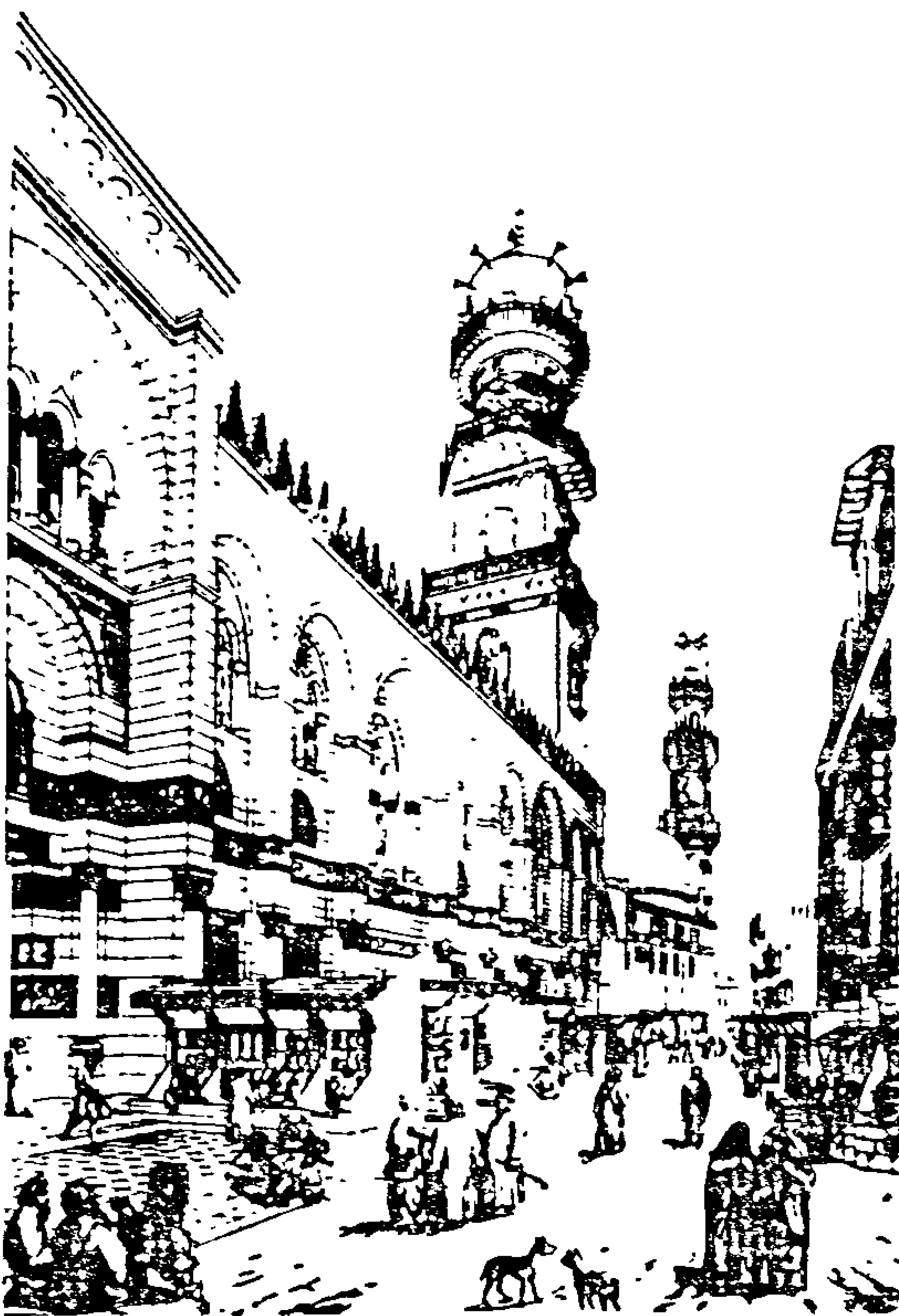


Fig. 3.

All these transformations affect the existing character and meaning of architecture as a whole.

Another older example is El-Bagawat Village, (EL-KHARGA Oasis). It was built and inhabited by the coptic refugees, who escaped from the Romans to he Southern oasis of Egypt, loaded with the architecture & character of the enemy, simply because it was the available technology at that time. After nineteen centuries, Hassan Fathy was inspired by its remains and utilized its values in his Gourna Village (1940) at Luxur.

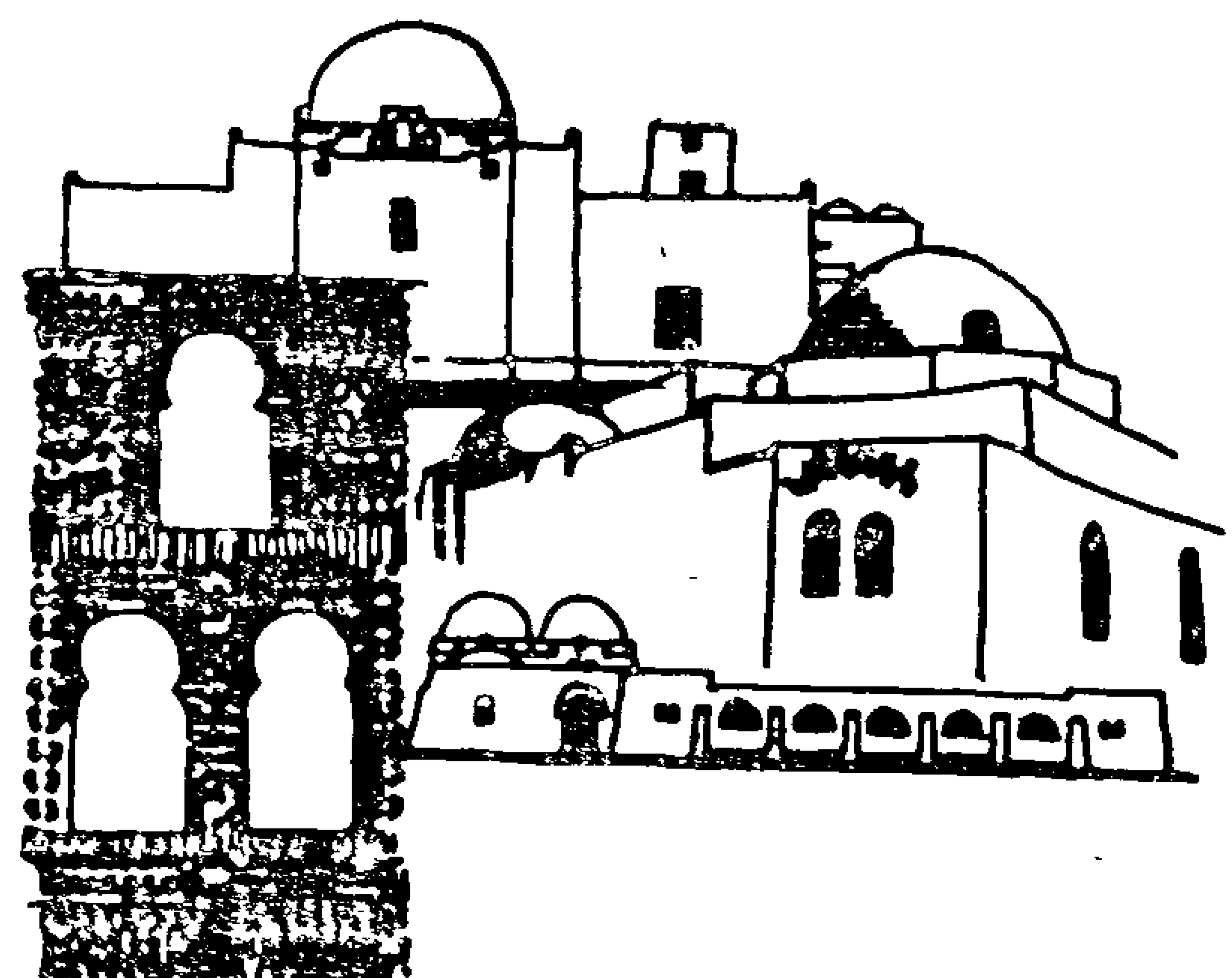


Fig. 4.

MEANING OF LOCAL ARCHITECTURE

Dr. MEDHAT DORRA

CONTENTS

OLD FASHION CHARACTER

Old fashion character is man made. Man created it, lived with it, believed in it, was satisfied by it and wanted to keep on with it. The reason is simply because he did not want to scope or perceive any other inputs, ideas or feeling.

The Contemporary meaning of nowadays character is totally different. When an architect creates something, believes in its aspects and meanings he recognizes that what might be called character is subject to change and might be oriented without limits. That defines a new meaning of character, a changing and growing meaning which might be contradictory to the prevailing, known and familiar.

Mostly, all buildings and architectural forms are evoked and related to a certain concept due to a certain context. The main forces that influence the architectural creativity are the economic, social, political and religious aspect. Whether it is an aspect or a process, it is subject to transformation and change according to the different, changing circumstances and events.

Egypt is a very vital example. It has been subject to many different impacts, like military invasions. When these invasions failed to achieve their military goal, they tried to transform it into cultural and social invasions. Egypt as a society, was affected by the influence of some of these invasions, changed and even lost its identity and character. Although in some cases it influenced them, some conquerers came to stay, but they have gone without a trace.

The AMR IBN ELAAS Mosque (622 A.D.) (the first mosque built in EGYPT), is an example of another transformation. A manifestation of a new epoch with its concepts of human existence. These concepts and ideas were expressed architecturally in new forms, spaces and detailings. These elements were produced by utilizing the same existing local materials, in the same climatic variables for the same people, but with different minds and hearts. New concepts produced new constraints, generated new atitudes of thinking leading to a new art and architecture

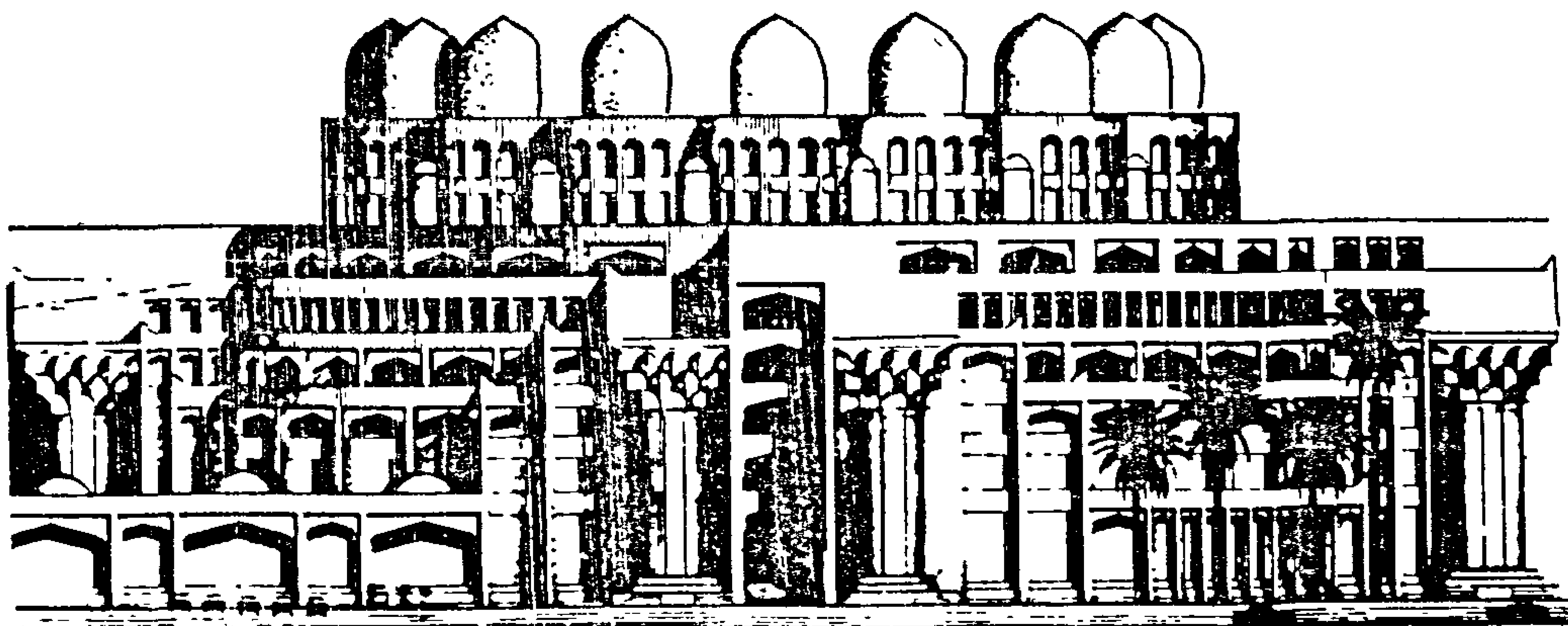


Fig. 1.

2. AT SIDE WALLS

$$CS_{[3(n-1)+2]} + SS_{[3(n-1)+3]}$$
$$+ BS_{[3(n-1)+4]} + WS_{[3(n-]1)+5]}$$
$$+ FS_{[3(n-1)+6]} = Z_{(5n+2)}$$

3. AT BACK WALL

$$CB_{[3(n-1)+2]} + SB_{[3(n-1)+3]}$$
$$+ WB_{[3(n-1)+5]} + FB_{[3(n-1)+6]}$$
$$= Z_{(5n+3)}$$

4. AT WINDOW WALL

$$CW_{[3(n-1)+2]} + SW_{[3(n-1)+3]}$$
$$+ BW_{[3(n-1)+4]} + FW_{[3(n-1)+6]}$$
$$= Z_{(5n+4)}$$

5. AT FLOOR

$$CF_{[3(n-1)+2]} + SF_{[3(n-1)+3]}$$
$$+ BF_{[3(n-1)+4]} + WF_{[3(n-1)+5]}$$
$$= Z_{(5n+5)}$$

Where n, is the number of interreflections occuring inside the room.

CAB - Reflected Sunlight Reaching Reference Position After Each Interreflection

$$CX_{[5(n-1)+2]} + SX_{[5(n-1)+3]}$$
$$+ BX_{[5(n-1)+4]} + WX_{[5(n-1)+5]}$$
$$+ FX_{[5(n-1)+6]} = ARS_m$$

Where n, is the number of interreflections occuring inside the room and m, is the number of interreflections reaching the reference position chosen from the internal walls, ceiling and floor of the room.

Hence the mathematical model is composed of the previous main operations formed as can be seen in the flow chart (Fig. 11) and are as follows :

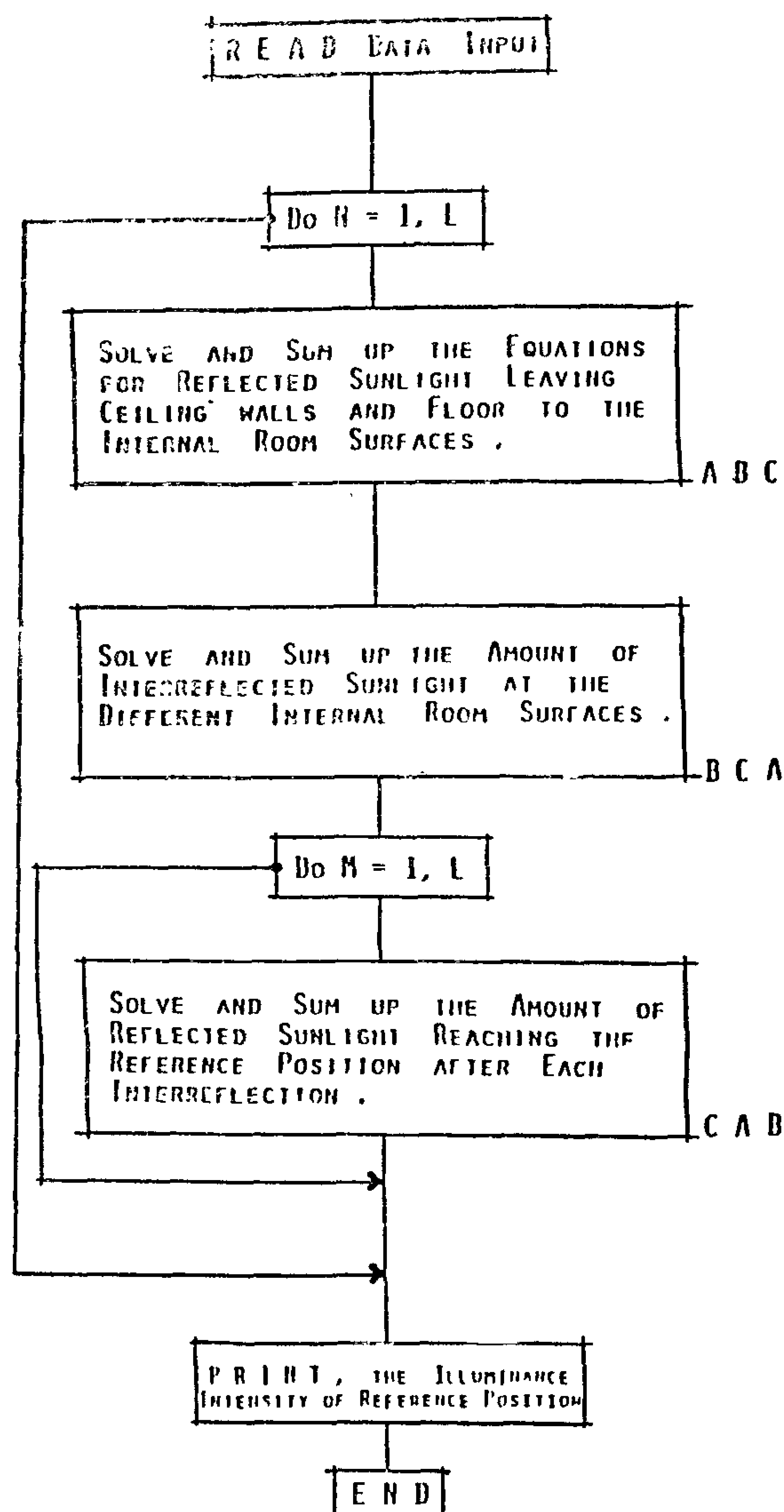


Fig. 11 : Flow Chart of the mathematical Model Programmed.

A B C - Slove and sum up the equations for reflected sunlight leaving the ceiling, internal walls and floor to the internal room surfaces.

A B C - Solve and sum up the amount of interreflected sunlight at the diferent internal room surfaces.

C A B - Solve and sum up the amount of reflected sunlight reaching the reference position after each reflection.

The formation and verification of the mathematical model will lead simultaneously to architectural design aids in order to stimulate and guide architects to re-examine conditions that have become, by time, familiar to them.

e. To the window wall;

$$Z_{[5(n-1)+2]} \cdot F_{35} \cdot R_w = SW_{[5(n-1)+3]}$$

f. To the floor;

$$Z_{[5(n-1)+2]} \cdot F_{36} \cdot R_w = SF_{[5(n-1)+3]}$$

3. BACK WALL

The amount of reflected sunlight leaving the back wall to the internal room surfaces. from (E) and (1) :

a. To the reference position;

$$Z_{[5(n-1)+3]} \cdot F_{41} \cdot R_w = BX_{[5(n-1)+4]}$$

b. To the ceiling;

$$Z_{[5(n-1)+3]} \cdot F_{24} \cdot R_w = BC_{[5(n-1)+4]}$$

c. To the side walls;

$$2Z_{[5(n-1)+3]} \cdot F_{34} \cdot R_w = BS_{[5(n-1)+4]}$$

d. To the window wall;

$$Z_{[5(n-1)+3]} \cdot F_{45} \cdot R_w = BW_{[5(n-1)+4]}$$

e. To the floor;

$$Z_{[5(n-1)+3]} \cdot F_{46} \cdot R_w = BF_{[5(n-1)+4]}$$

4. WINDOW WALL

The amount of reflected sunlight leaving the window wall to the internal room surfaces from (J) :

a. To the reference position;

$$Z_{[5(n-1)+4]} \cdot F_{51} \cdot R_w = WX_{[5(n-1)+5]}$$

b. To the ceiling;

$$Z_{[5(n-1)+4]} \cdot F_{25} \cdot R_w = WC_{[5(n-1)+5]}$$

c. To the side walls;

$$2Z_{[5(n-1)+4]} \cdot F_{35} \cdot R_w = WS_{[5(n-1)+5]}$$

d. To the back wall;

$$Z_{[5(n-1)+4]} \cdot F_{45} \cdot R_w = WB_{[5(n-1)+5]}$$

e. To the floor;

$$Z_{[5(n-1)+4]} \cdot F_{56} \cdot R_w = WF_{[5(n-1)+5]}$$

5. FLOOR

The amount of reflected sunlight leaving the floor to the internal room surfaces. from (K) :

a. To the reference position;

$$Z_{[5(n-1)+5]} \cdot F_{61} \cdot R_f = FX_{[5(n-1)+6]}$$

b. To the ceiling;

$$Z_{[5(n-1)+5]} \cdot F_{26} \cdot R_f = FC_{[5(A-1)+6]}$$

c. To the side walls;

$$2Z_{[5(n-1)+5]} \cdot F_{36} \cdot R_f = FS_{[5(n-1)+6]}$$

e. To the back wall;

$$Z_{[5(n-1)+5]} \cdot F_{46} \cdot R_f = FB_{[5(n-1)+6]}$$

d. To the window wall;

$$Z_{[5(n-1)+5]} \cdot F_{56} \cdot R_f = FW_{[5(n-1)+6]}$$

BAC - Interreflected Sunlight At Different Room Surfaces After Each Interreflection :

1. AT CEILING

$$SC_{[3(n-1)+3]} + BC_{[3(n-1)+4]}$$
$$+ WC_{[3(n-1)+5]} + FC_{[3(n-1)+6]}$$
$$= Z_{(5n+1)}$$

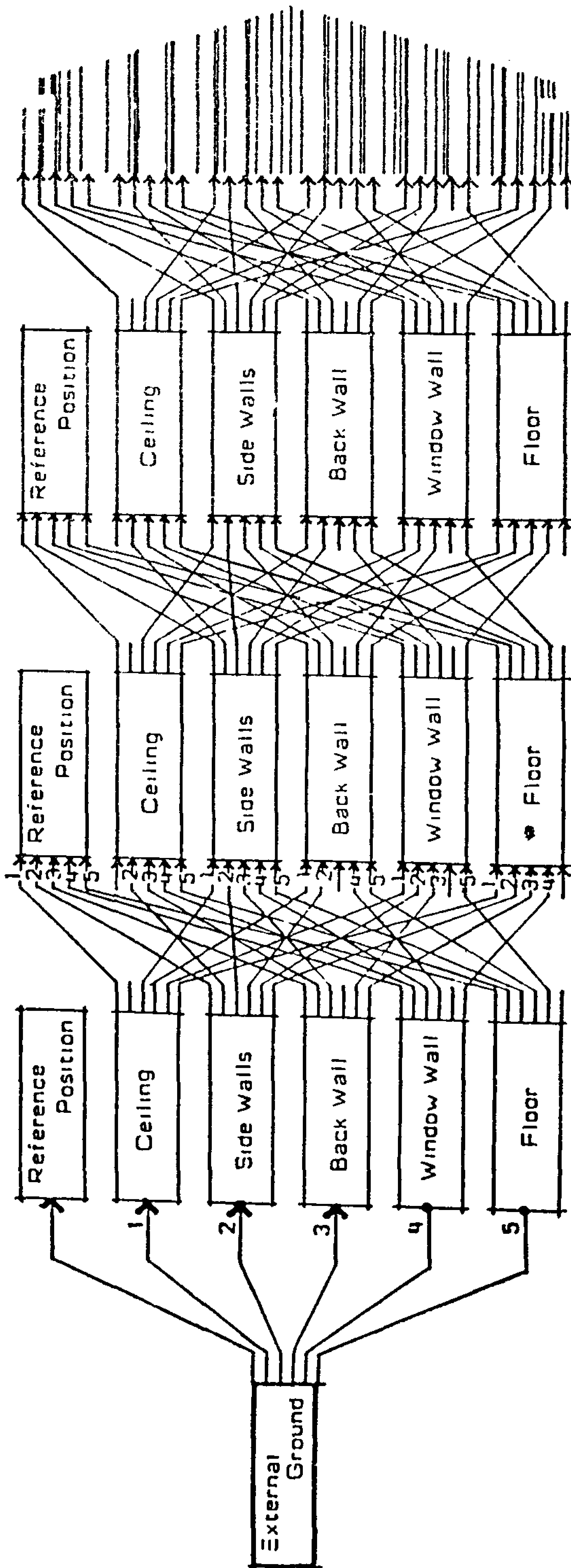


Fig. 10 : The Figure Shows the Procedure through which the Solar Radiation Will Go through Once Entering a Room till Completely fading out.

A B C - Reflected Sunlight Leaving The Ceiling, Walls And Floor :

1. CEILING LEVEL

The amount of reflected sunlight leaving the ceiling to the internal room surfaces. from (C) and (G) :

a. To the reference position;

$$Z_{[5(n-1)+1]} \cdot F_{21} \cdot R_c = CX_{[5(n-1)+2]}$$

b. To the side walls;

$$2Z_{[5(n-1)+1]} \cdot F_{23} \cdot R_c = CS_{[5(n-1)+2]}$$

c. To the back wall;

$$Z_{[5(n-1)+1]} \cdot F_{24} \cdot R_c = CB_{[5(n-1)+2]}$$

d. To the window wall;

$$Z_{[5(n-1)+1]} \cdot F_{25} \cdot R_c = CW_{[5(n-1)+2]}$$

e. To the floor;

$$Z_{[5(n-1)+1]} \cdot F_{26} \cdot R_c = CF_{[5(n-1)+2]}$$

Where (n) is the number of interreflection occurring inside the room.

2. SIDE WALLS

The amount of reflected sunlight leaving the side walls to the internal room surfaces. from (D) and (H) :

a. To the reference position;

$$Z_{[5(n-1)+2]} \cdot F_{31} \cdot R_w = SX_{[5(n-1)+3]}$$

b. To the ceiling;

$$Z_{[5(n-1)+2]} \cdot F_{23} \cdot R_w = SC_{[5(n-1)+3]}$$

c. To the side walls;

$$Z_{[5(n-1)+2]} \cdot F_{33} \cdot R_w = SS_{[5(n-1)+3]}$$

d. To the back wall

$$Z_{[5(n-1)+2]} \cdot F_{34} \cdot R_w = SB_{[5(n-1)+3]}$$

c. the side walls

$$2Z_8 \cdot F_{34} \cdot R_w = BS_9$$

d. the window wall;

$$Z_8 \cdot F_{45} \cdot R_w = BW_9$$

e. the floor;

$$Z_8 \cdot F_{46} \cdot R_w = BF_9$$

Where Z_8 , is the amount of interreflected sunlight at the backwall after the first interreflection (Fig. 7).

L. The amount of sunlight leaving the window wall to :

a. the reference position;

$$Z_9 \cdot F_{51} \cdot R_w = WX_{10} \qquad (10)$$

b. the ceiling ;

$$Z_9 \cdot F_{25} \cdot R_w = WC_{10}$$

c. the side walls;

$$2Z_9 \cdot F_{35} \cdot R_w = WS_{10}$$

d. the back wall;

$$Z_9 \cdot F_{45} \cdot R_w = WB_{10}$$

e. the floor;

$$Z_9 \cdot F_{56} \cdot R_w = WF_{10}$$

where Z_9 , is the amount of interreflected sunlight at the window wall after the first interreflection (Fig. 8).

M. The amount of sunlight leaving the floor to :

a. the reference position;

$$Z_{10} \cdot F_{61} \cdot R_f = FX_{11} \qquad (11)$$

b. the ceiling;

$$Z_{10} \cdot F_{26} \cdot R_f = FC_{11}$$

c. the side walls;

$$2Z_{10} \cdot F_{36} \cdot R_f = FS_{11}$$

d. the back wall;

$$Z_{10} \cdot F_{46} \cdot R_f = FB_{11}$$

e. the window wall;

$$Z_{10} \cdot F_{56} \cdot R_f = FW_{11}$$

Where Z_{10}, is the amount of interreflected sunlight at the floor after the first interreflection, (Fig. 9).

Following the second interreflection between the ceiling, the interior walls and the floor, the amount of interreflected sunlight at the diferent internal room surfaces will be :

a. At the ceiling, from H,I,J and K.

$$SC_6 + BC_7 + WC_8 + FC_9 = Z_{11}$$

b. At the side walls, from G,H,I,J,and K.

$$CS_5 + SS_6 + BS_7 + WS_8 + FS_9 = Z_{12}$$

c. At the back wall, from G.H,J and K.

$$CB_5 + SB_6 + WB_8 + FB_9 = Z_{13}$$

d. At the window wall, fromG,H,I, and K.

$$CW_5 + SW_6 + BW_7 + FW_9 = Z_{14}$$

e. At the floor, from G,H,I and J.

$$CF_5 + SF_6 + BF_7 + WF_8 = Z_{15}$$

The interreflected sunlight reaching the ceiling, the side walls, back wall, window wall and floor after the second interreflection will proceed through a series of intereflections (third, fourth, ...etc) finalizing with the fading out of the original magnitude (Fig. 10).

Finally, we can deduct and construct from the previous equations a general equation of the series of interreflections occuring inside the room.

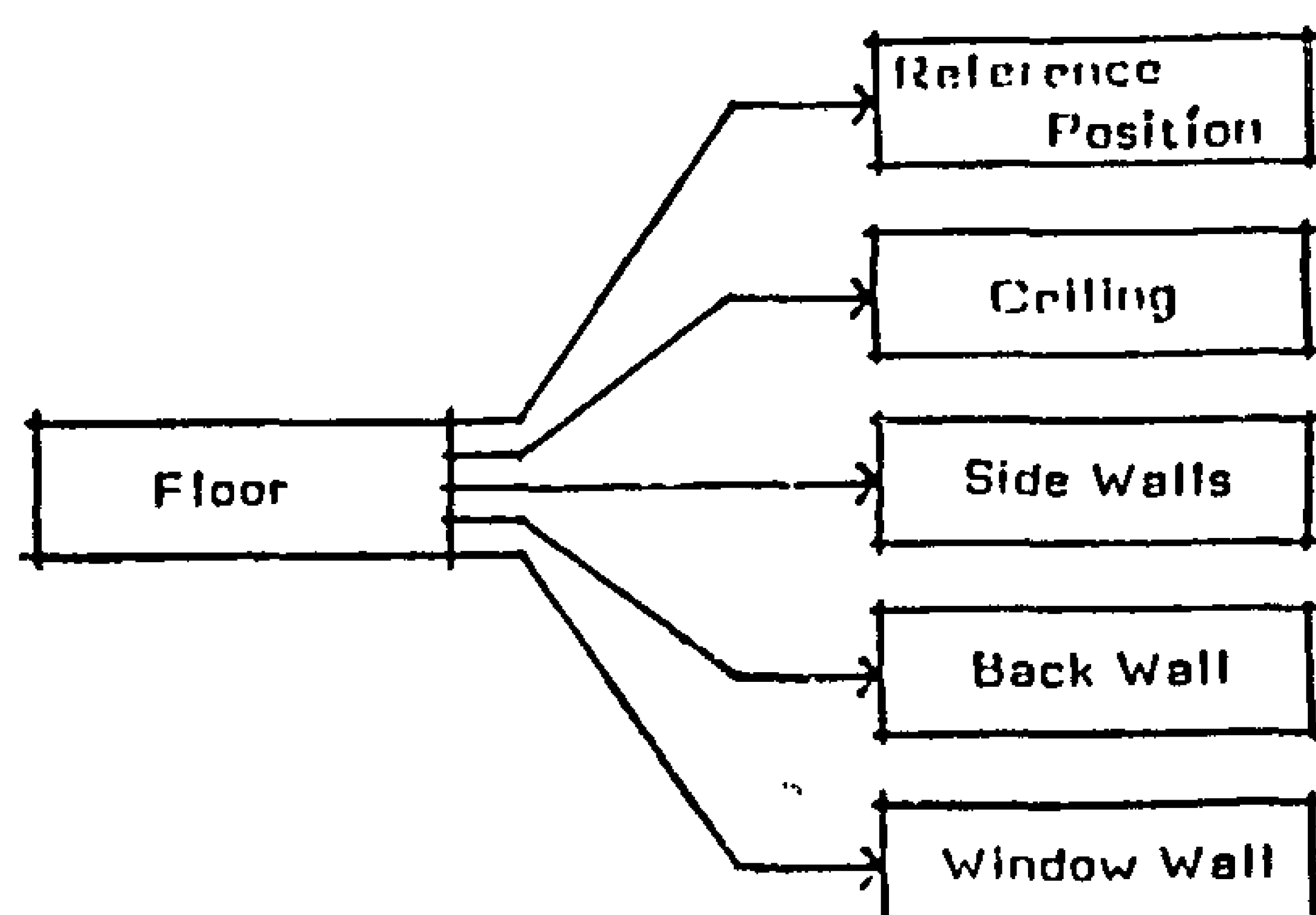


Fig. 9 : The Reflected Sunlight Reaching the Floor Will be Reflected onto the Reference Position, Ceiling Side Walls, Back Wall and Window Wall.

H. After the first interreflection between the ceiling, the interior walls and the floor, the amount of interreflected sunlight at the different internal room surface would be :

a. At the ceiling, from D and E.

$$SC_3 + BC_4 = Z_6$$

b. At the side walls, from C,D, and E.

$$CS_2 + SS_3 + BS_4 = Z_7$$

c. At the back wall, from C and D.

$$CB_2 + SB_3 = Z_8$$

d. At the window wall, from C,D, and E.

$$CW_2 + SW_3 + BW_4 = Z_9$$

e. At the floor, from C, D, and E.

$$CF_2 + SF_3 + BF_4 = Z_{10}$$

The interrefleced sunlight reaching the ceiling, the side walls, back wall, window wall and floor after the first reflection will then proceed through the second interreflection.

I. The amount of sunlight leaving the ceiling to :

a. the reference position;

$$Z_6 \cdot F_{21} \cdot R_c = CX_7 \qquad (7)$$

b. the side walls;

$$2Z_6 \cdot F_{23} \cdot R_c = CS_7$$

c. the back wall;

$$Z_6 \cdot F_{24} \cdot R_c = CB_7$$

d. the window wall;

$$Z_6 \cdot F_{25} \cdot R_c = CW_7$$

e. the floor;

$$Z_6 \cdot F_{26} \cdot R_c = CF_7$$

Where Z_6 , is the amount of interreflected sunlight at the ceiling after the first interreflection (Fig. 5).

J. The amount of sunlight leaving the side walls to :

a. the reference position;

$$Z_7 \cdot F_{31} \cdot R_w = SX_8 \qquad (8)$$

b. the ceiling;

$$Z_7 \cdot F_{23} \cdot R_w = SC_8$$

c. themselves;

$$Z_7 \cdot F_{33} \cdot R_w = SS_8$$

d. the back wall;

$$Z_7 \cdot F_{34} \cdot R_w = SB_8$$

e. the window wall;

$$Z_7 \cdot F_{35} \cdot R_w = SW_8$$

f. the floor;

$$Z_7 \cdot F_{36} \cdot R_w = SF_8$$

Where Z_7 , is the amount of interreflected sunlight at the side walls after the first interreflection (Fig. 6).

K. The amount of sunlight leaving the back wall to :

a. the reference position;

$$Z_8 \cdot F_{41} \cdot R_w = BX_9 \qquad (9)$$

b. the ceiling;

$$Z_8 \cdot F_{24} \cdot R_w = BC_9$$

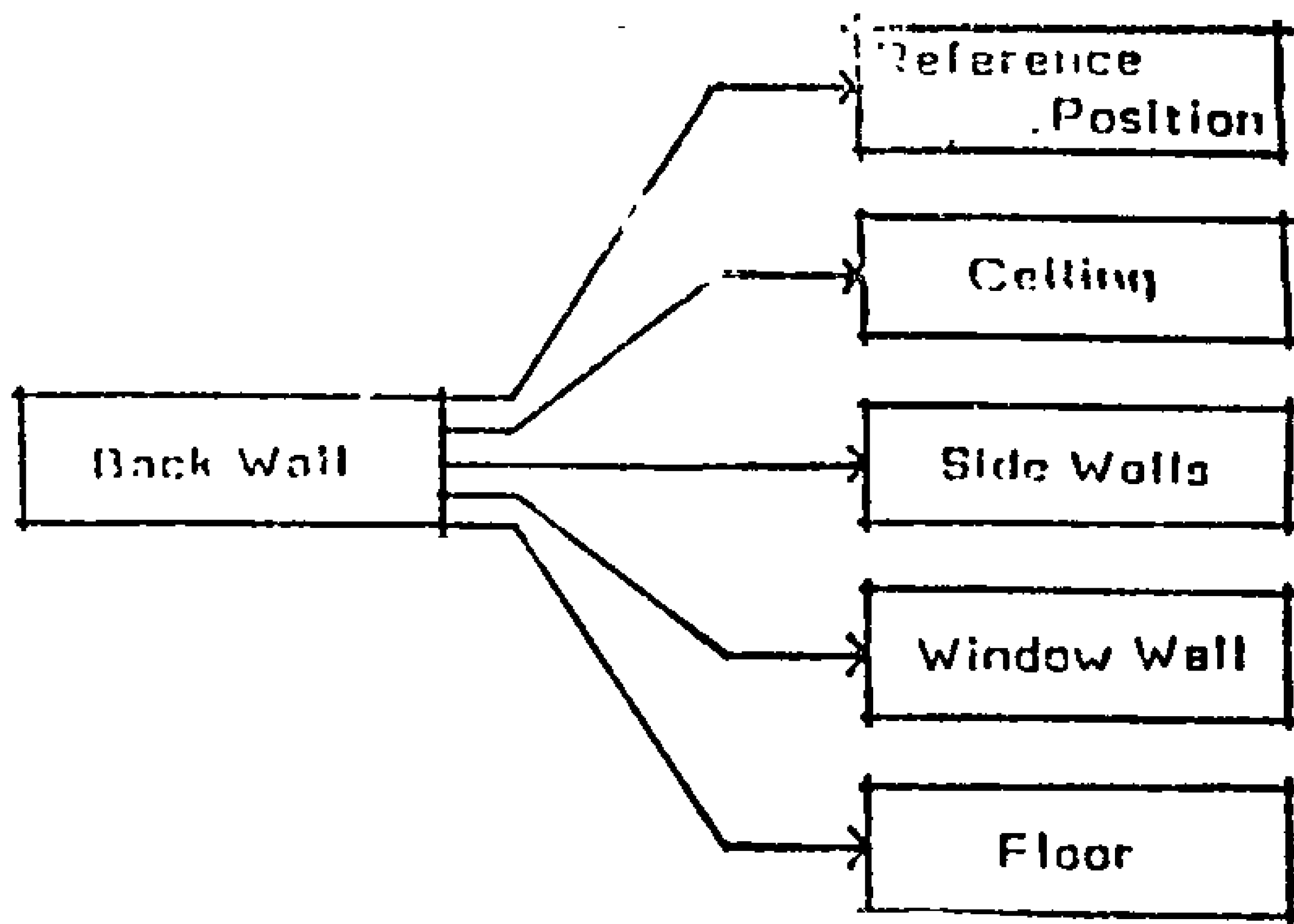


Fig. 7: The Reflected Sunlight Reaching the Back Wall will Be Reflected onto the Reference Position, Ceiling Side, Walls, Window Wall and Floor.

F. The amount of sunlight leaving the Window Wall and Floor.

a. the reference Position;

$$Z_4 \cdot F_{51} \cdot R_w = WX_5 \qquad (5)$$

b. the ceiling;

$$Z_4 \cdot F_{25} \cdot R_w = WC_5$$

c. the side walls;

$$2Z_4 \cdot F_{35} \cdot R_w = WS_5$$

d. the back wall;

$$Z_4' \cdot F_{45} \cdot R_w = WB_5$$

e. the floor;

$$Z_4' \cdot F_{56} \cdot R_w = WF_5$$

Where Z_4, is the amount of reflected sunlight at the window wall after the first interreflection and F_{51}, F_{25}, F_{35} F_{45} and F_{56} are the form factors between the window wall and the reference position, the ceiling, the side walls, the back wall and the floor respectively (Fig. 8).

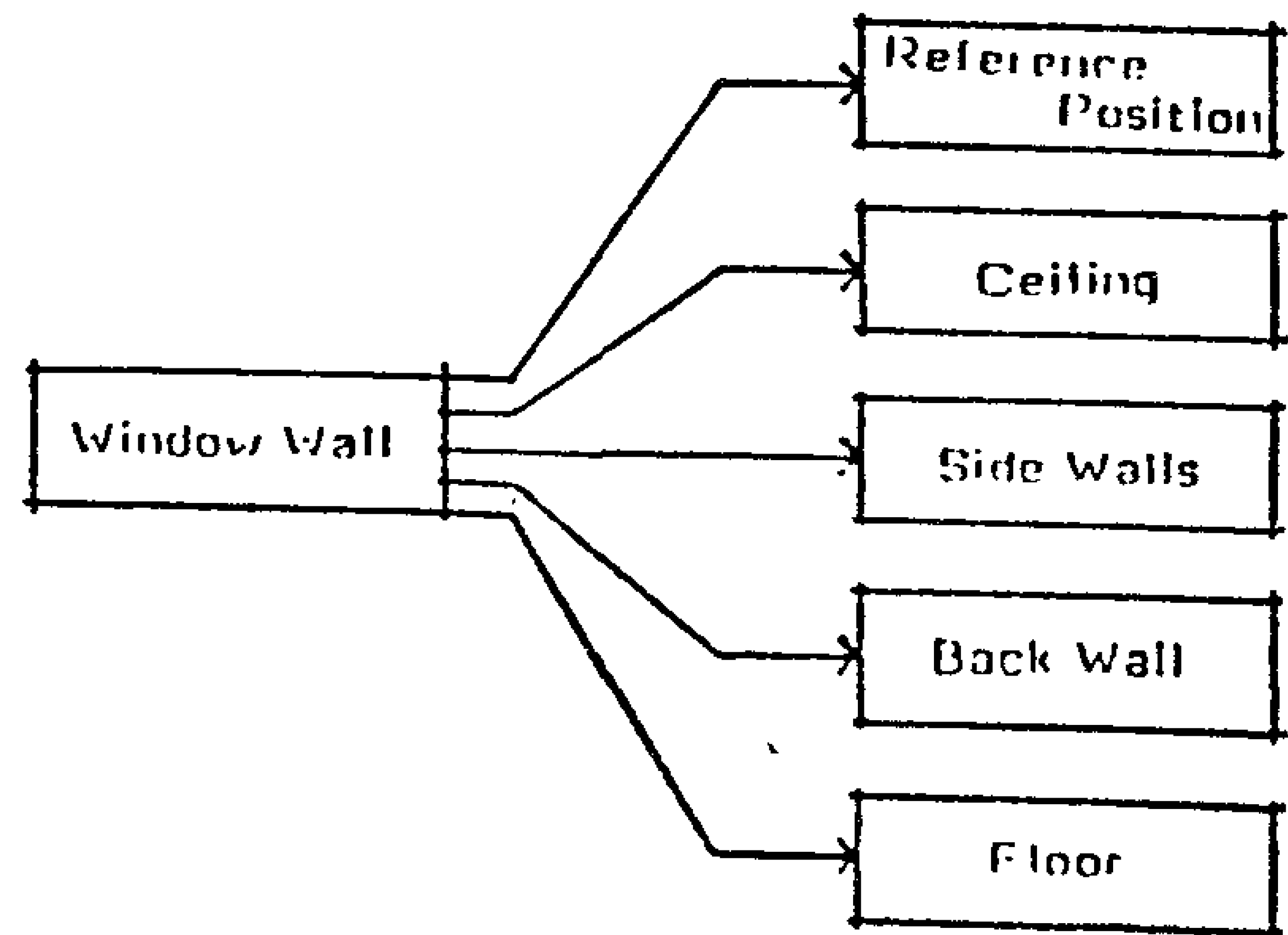


Fig. 8 : The Reflected Sunlight Reaching the Window Wall Will Be reflected onto the Reference Position. Ceiling Side Walls Back Wall and Floor .

G. The amount of sunlight leaving the floor to :

a. the reference position;

$$Z_5 \cdot F_{61} \cdot R_f = FX_6 \qquad (6)$$

b. the ceiling;

$$Z_5 \cdot F_{26} \cdot R_f = FC_6$$

c. the side walls;

$$2Z_5 \cdot F_{36} \cdot R_f = FS_6$$

d. the back wall;

$$Z_5 \cdot F_{46} \cdot R_f = FB_6$$

e. the window wall;

$$Z_5 \cdot F_{56} \cdot R_B = FW_6$$

Where Z_5, is the amount of reflected sunlight at the floor, and F_{61}. F_{26}.F_{36}. F_{46}. and F_{56}, are the form factors between the floor and the reference position, the ceiling, the side walls, the back wall and the window wall respectively (Fig. 9).

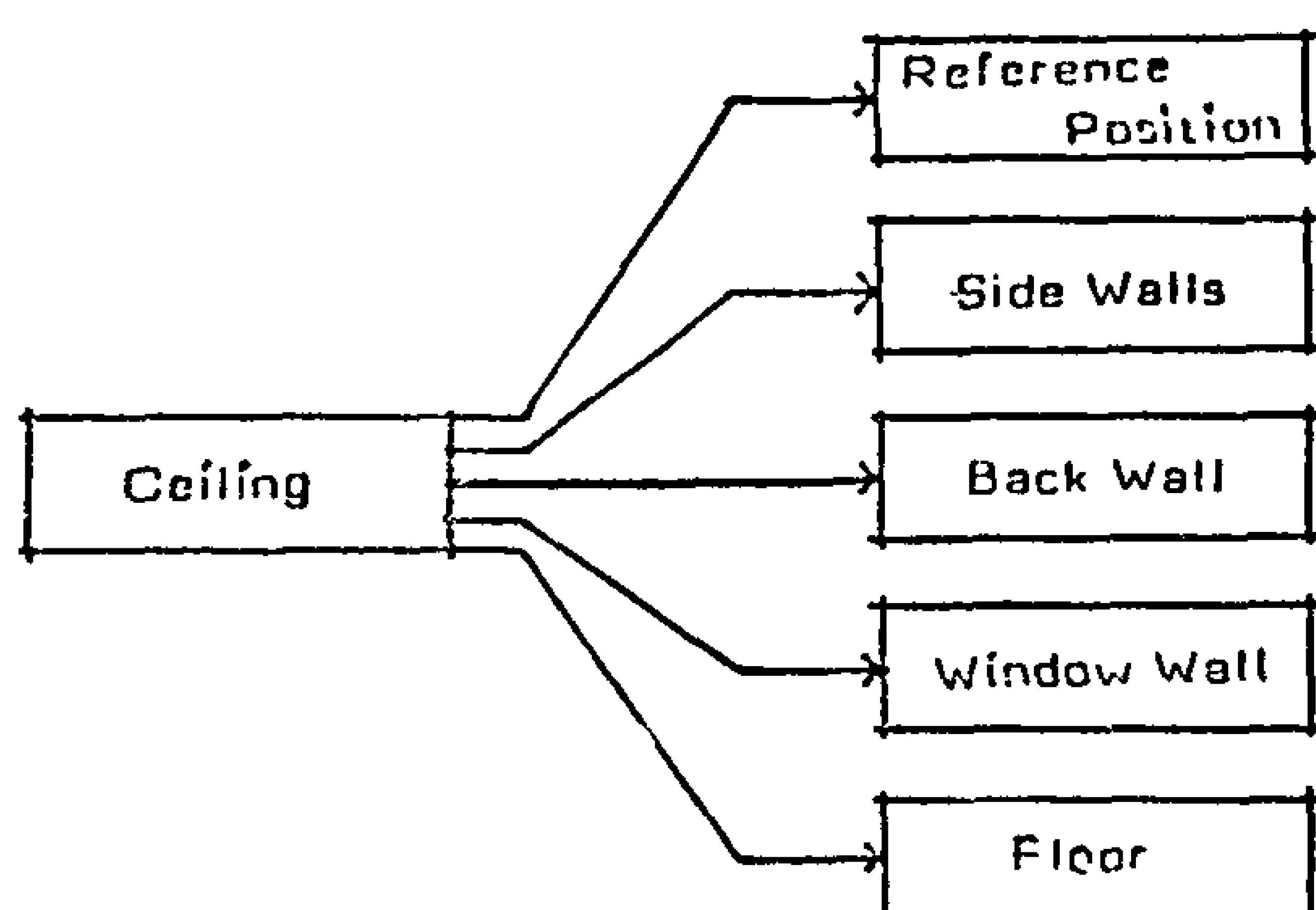


Fig. 5 : The Reflected Sunlight Reaching the Ceiling Will Be Reflected onto the Reference Position, Side Walls, Back Wall, Window Wall and Floor.

D. The amount of sunlight leaving the side walls to,

a. the reference position;

$$Z_2 \cdot F_{31} \cdot R_W = SX_3 \qquad (3)$$

b. the ceiling;

$$Z_2 \cdot F_{23} \cdot R_W = SC_3$$

c. themselves;

$$Z_2 \cdot F_{33} \cdot R_W = SS_3$$

d. the back wall;

$$Z_2 \cdot F_{34} \cdot R_W = SB_3$$

e. the window wall;

$$Z_2 \cdot F_{35} \cdot R_W = SW_3$$

f. the floor

$$Z_2 \cdot F_{36} \cdot R_W = SF_3$$

Where Z_2 , is the amount of reflected sunlight at the side walls, R_w is the reflectivity of the side walls and $F_{31} \cdot F_{23} \cdot F_{33} \cdot F_{34} \cdot F_{35}$ and F_{36} . are the form factors between the side walls and the reference position, the ceiling, the side walls themselves, the back wall, the window wall and the floor respectively (Fig. 6).

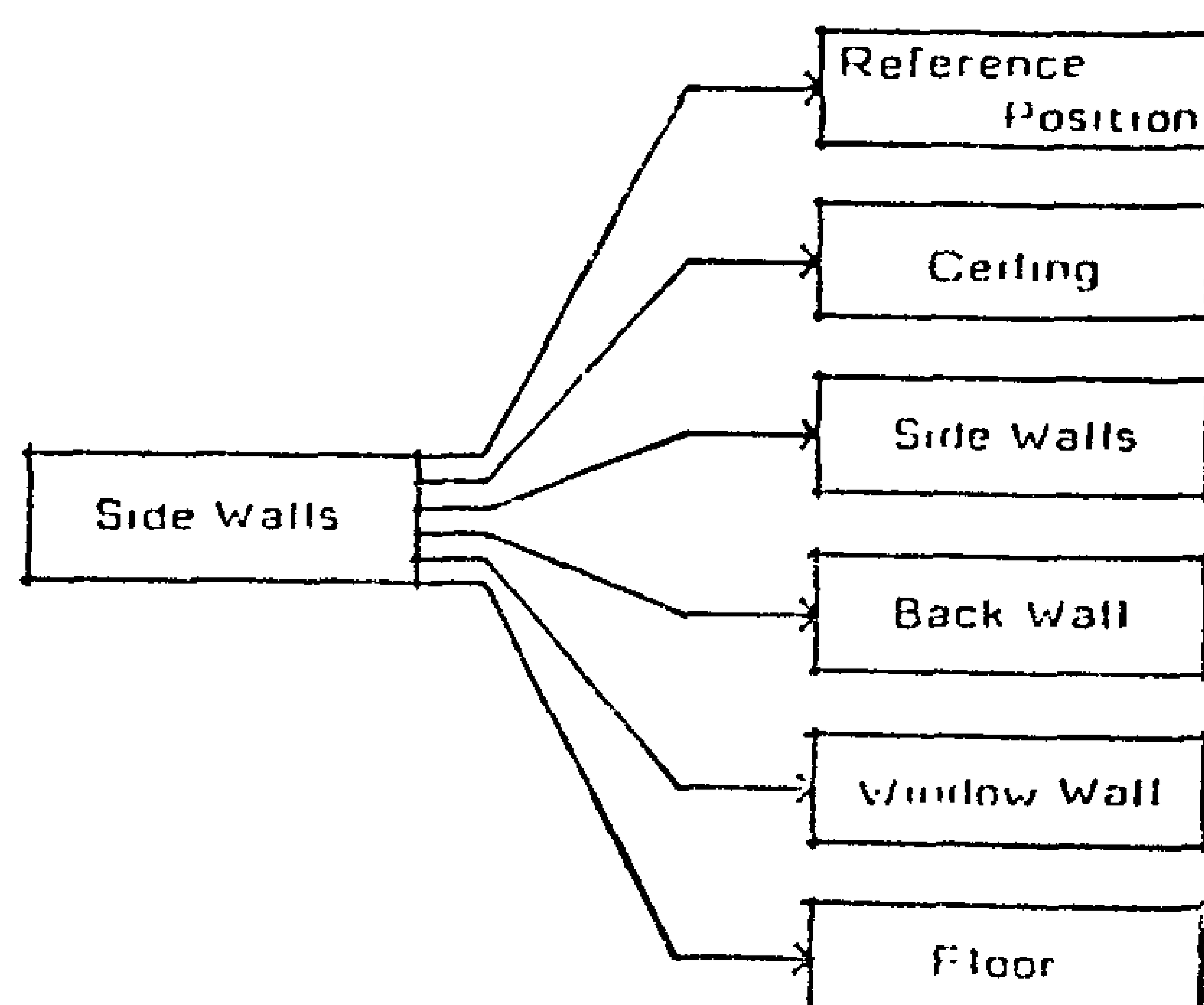


Fig. 6 : The Reflected Sunlight Reaching the Side Walls Will Be Reflected onto the Reference Position, Ceiling, Themselves, Back Wall, Window Wall and Floor.

E. The amount of sunlight leaving the back wall to :

a. the reference position;

$$Z_3 \cdot F_{41} \cdot R_W = BX_4 \qquad (4)$$

b. the ceiling;

$$Z_3 \cdot F_{24} \cdot R_W = BC_4$$

c. the side walls;

$$2Z_3 \cdot F_{34} \cdot R_W = BS_4$$

d. the window wall;

$$Z_3 \cdot F_{45} \cdot R_W = BW_4$$

e. the floor;

$$Z_3 \cdot F_{46} \cdot R_W = BF_4$$

Where Z_3 , is the amount of reflected sunlight at the backwall, R_o is the reflectivity of the back wall, and $F_{41} \cdot F_{24} \cdot F_{34}$ F_{45} and F_{46} are the form factors between the back wall and the reference position, the ceiling, the side walls, the window wall and the floor respectively (Fig. 7).

d. the back wall;

$$I_o R_o F_4 = Z_3$$

e. the window wall;

none $= Z_4$

f. the floor

none $= Z_5$

Where R_o, is the reflectivity of the external ground and F_1, F_2, F_3, and F_4 are the form factors* occurring between the external ground and the reference position, the ceiling, the side walls and the back wall respectively.

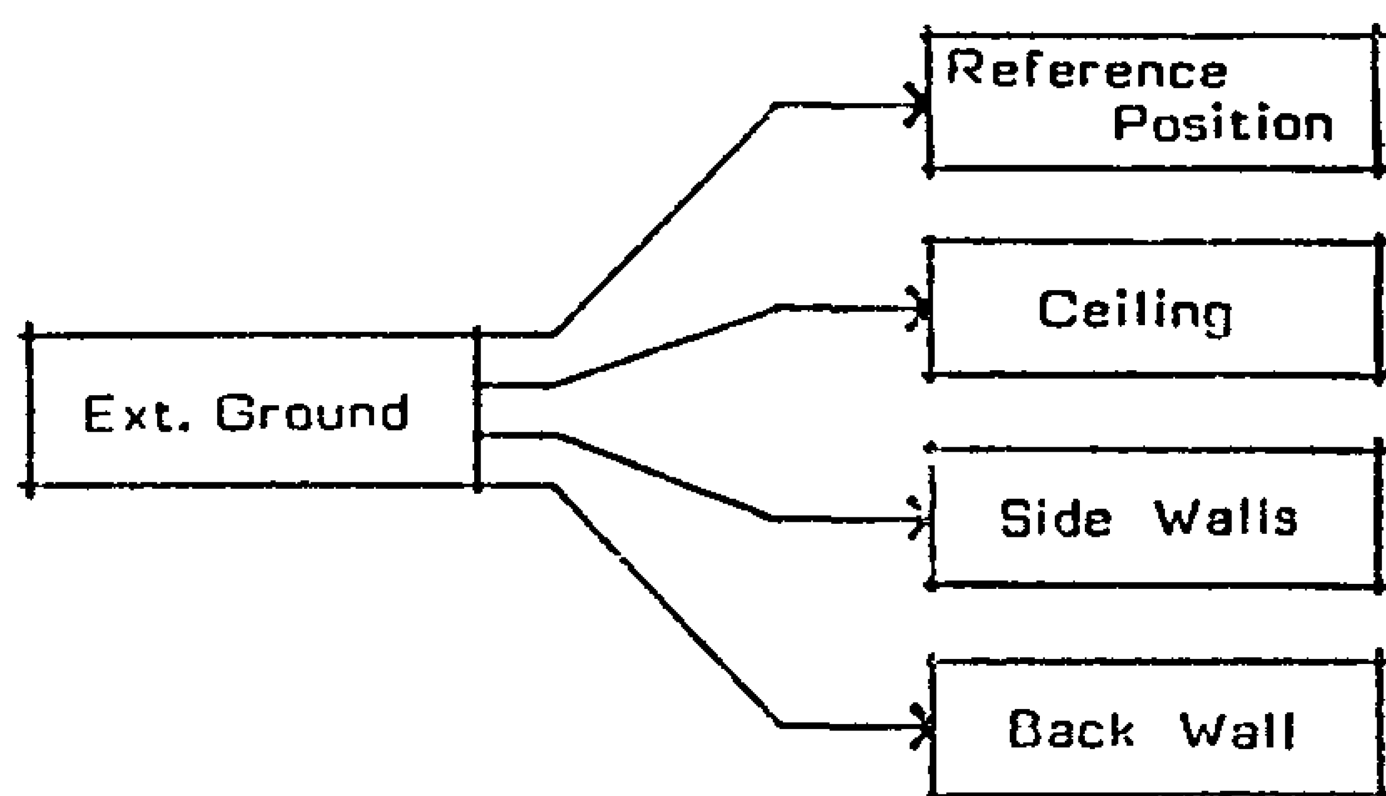


Fig.3 : The Sunlight is Reflected off the External Ground through the Window Aperture onto the Reference Position. Ceiling Side Walls and Back Wall.

The reflected sunlight reaching the ceiling, side walls and back wall will then start going through the first interreflection inside the room.

C. The amount of sunlight leaving the ceiling to,

a. the reference position;

$$Z_1 \cdot F_{21} \cdot R_c = CX_2 \qquad (2)$$

b. the side wals;

$$2Z_1 \cdot F_{23} \cdot R_c = CS_2$$

c. the back wall;

$$Z_1 \cdot F_{24} \cdot R_c = CB_2$$

d. the window wall;

$$Z_1 \cdot F_{25} \cdot R_c = CW_2$$

e. the floor;

$$Z_1 \cdot F_{26} \cdot R_c = CF_2$$

Where Z_1, is the amount of reflected sunlight at the ceiling, R_o is the reflectivity of the ceiling and F_{21}, F_{23}, F_{24} F_{25}, and F_{26} are the form factors between the ceiling and the reference position, the side walls, the back well, the window wall and the floor respectively (Fig. 5).

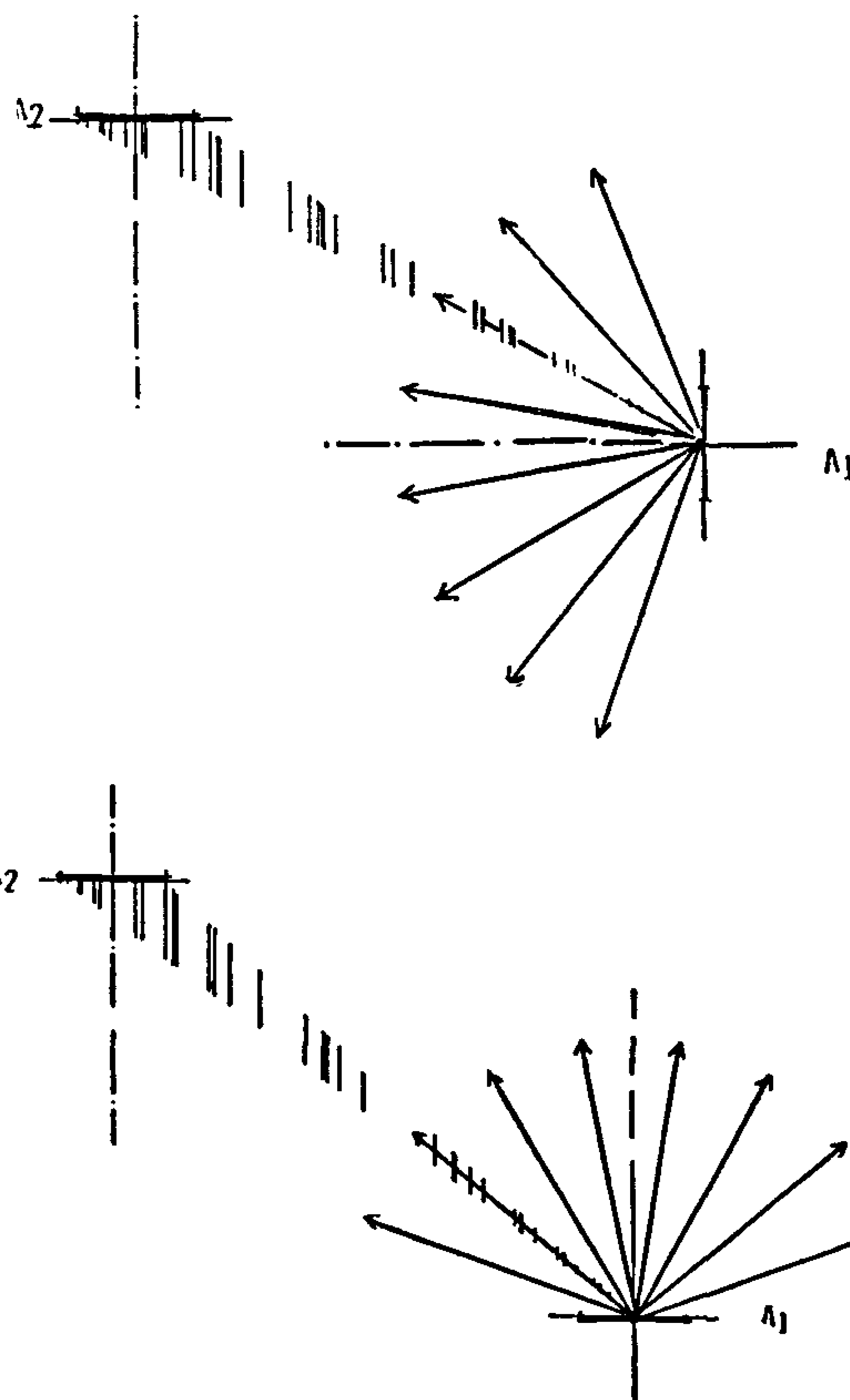


Fig. 4 : Both Figures Show the Radiation Exchange between Two Different Geometrical Arrangements.

*The form factor, is the fraction of radiation leaving surface A_1 in all directions which is interrupted by surface A_2 Fig. 4.

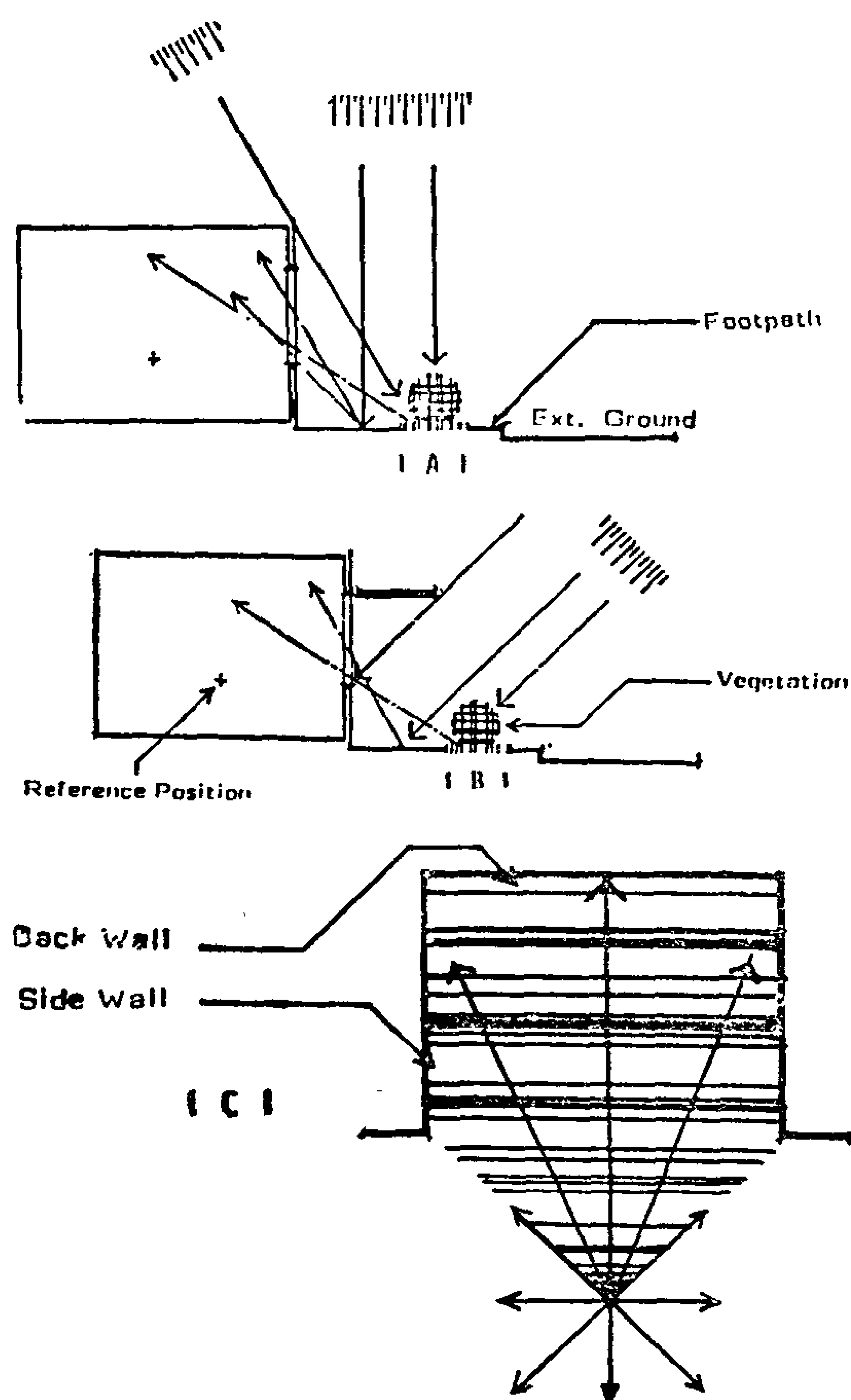


Fig. 1 (A and B) : Section through the Model Room in which the Sun is either:-

A- Above or behind the Model

B. Facing the Model

(In this case, the direct sunbeam is excluded by means of a single horizontal sunbraker).

Fig. I.C: Plan of Model Room. Emphasizing the Passage of the Reflected Sunbeam toward the side Walls, Reference Position, ceiling and back wall.

The formation and design of a mathematical model in order to calculate the internal room illuminance is a very tedious procedure, especially in going through the series of interreflections that occur inside the room. But a model is of extreme importance because of the human limitations faced within providing full scaled experimental models with all the variables and parameters needed.

This will be followed by the completion and verification of the results obtained by the mathematical model against experimental results in the proceeding papers, in order to be able to provide the architect with environmental design aids in the relationship that could exist between the window size, shape, location, interior wall colours and the external landscape in their effect upon internal room illuminance, so a compromise between both the internal lighting and the thermal environments can be achieved,as well as energy conservation

To begin designing a mathematical model (that calculates the internal illuminance in a room), the steps, the radiation leaving the sun goes through, are to be taken in their natural sequence.

A. The sunlight falls upon the external landscape facing the window (Fig. 1(A and B.) and Fig. 2).

$$I_o,$$

where Io, is the magnitude of the external incident direct sunlight upon ground.

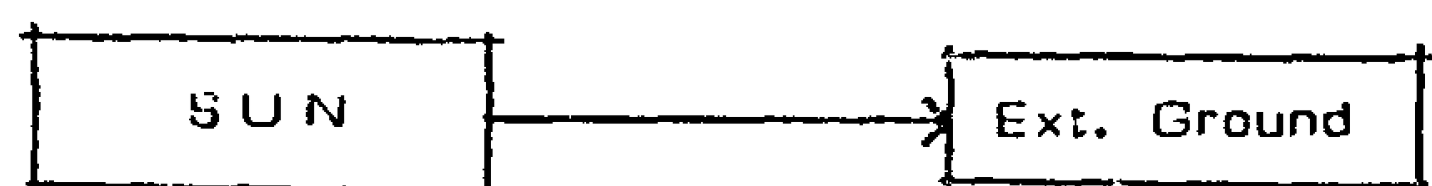


Fig. 2 : The Direct Sunbeam Falling upon the External Land Scape.

B. The sunlight is then reflected off the ground facing the window, through the window aperature onto the, reference position (centre of room at 90 cm above ground), ceiling the side walls and the back wall (Fig. 1C and Fig. 3).

Amount of reflected sunlight reaching,

a. the reference position;

$$I_o R_o F_1 = E \times 1 \quad (1)$$

b. the ceiling;

$$I_o R_o F_2 = Z_1$$

c. the side walls;

$$I_o R_o F_3 = Z_2$$

THE DESIGN AND FORMATION OF AMATHEMATICAL MODEL TO CALCULATE THE INTERNAL ILLUMINANCE (SUB-TROPICAL) CLIMATES)

Dr. Ahmed Fikry*

Normal sunlighting, is the most treasured source of internal lighting, and in low latidude regions (sub-tropical) strong bright sunligyt prevails throughout most of the year accompanied by a high mean daily temperature. The sky under the relatively stable conditions of the hot, dry sub-tropical climate is usually of very low luminance. Consequently, its brightness could not be considered as "the" principal source of interior illumination.

Fulfilling this function is the direct sunlight which falls uniterruptedly on the external landscape environment of buildings and the building facades facing them. These surfaces would have a luminance far well in excess of that reaching from the sky.

In this context, window aperature design becomes highly important in its effect upon the intensity, distribution and quality of sunlight penetrating a room, taking into consideration the importance of omitting solar heat radiation and glare, both being unwanted especially if they are in excessive quantities which is the condition actually prevailing in these climates. It is therefore natural that lighting technology in these hot dry climates, considers reflected sunlight as one of the main, if not the major, source of interior working illumination.

However, preserving the architectural traditions of the homeland presents a main issue and goal that challenges the architect and it is through best buildings that these objectives are achieved. Another alternative lies in the usage of imported traditions and applying them exclusively devoid of necessary modifications under completely different climatic conditions. This, in fact does not undermine the necessity of maintaining the basic and accepted principles of good lighting applied worldwide.

The external landscape of the building site, the surrounding buildings, and the interior surface reflectances of the rooms are the most important factors to be considered, when internal illuminance by natural means is discussed. Although the reflectances of the interior room surfaces do not have a direct effect upon the amount of sunlight penetrating the room but have a direct effect upon whatever quantity that enters through the window aperature. Proper use of the interior room colours can make both natural and artificial lighting more effective.

Throughout this paper, the design procedure of a mathematical model to detect the effect of both the external landscape (ranging from grassed to paved beds or paved roads and pavements) and the internal room surface reflectances upon the internal illuminance...will be described in detail. The window aperature has been oriented in a manner that no direct beam penetrates the room Fig. 1. (A,B and C).

* Lecturer, Department of Architecture, Cairo University.

(4) The consistant mass method (C.M.S), has demonstrated that modes of vibration other than the first one may occur. For design of such foundation, these modes should be considered while applying equation (1). The results of Fig. 6, demonstrate that excitation of a fifth mode may occur at a frequency of 95 cps which is a relatively close frequency to the machine frequency.

References:

1. El-Meligy, "Dynamic Analysis of Plane Frames Resting on Elastic Foundation". M.A. Sc. thesis, to be published 1988, Mansouta Univ., Egypt.
2. Richart, F.E., Jr., and Hall, J.R., and Woods, R.D., «Vibration of Soil and Foundation», Prentice-Hall, Inc., N.Y. 1970.
3. Hetengi, M., "Beam on Elastic Foundation", University of Michigan Prss, 1946.
4. Irish, K., and Walker, W.P., "Foundations of Reciprocating Machines", Concrete Publications LTD., 1969.

Notation:

a_i : distance of bent 'i' to centre of mass.

A_x : translation amplitude

A_θ : Rotation Amplitude, radians.

b_i : distance of individual bents to centre of rigidity.

D.M.F.: dynamic magnification factor.

E : Centre of rigidity.

c : distance between centres of mass and rigidity.

F_i : dynamic force at bent 'i'

H_i : Horizontal spring stiffness of bent 'i'.

[K']: Overall stiffness matrix of a beam on an elastic foundation.

$[K_o]$: Stiffness matrix for flexural deformation of a conventional beam element.

$[K_w]$: Contribution to the element stiffness matrix for flexural deformation due to winkler foundation.

$[K_a]$: Stiffness matrix of a beam element due to axial deformation.

$[K_t]$: Contribution to the element stiffness matrix due to the continuous horizontal springs.

m_i : mass of bent 'i'.

S : Centre of mass.

Λ : Total deflection.

Λ_c: axial deformation of columns.

Λ_B : bending deflection of beams.

Λ_s: Shear deflection of beams.

$W_e = W_m$: Driving frequancy, C.P.S.

W_{nx} = frequancy of lateral vibration.

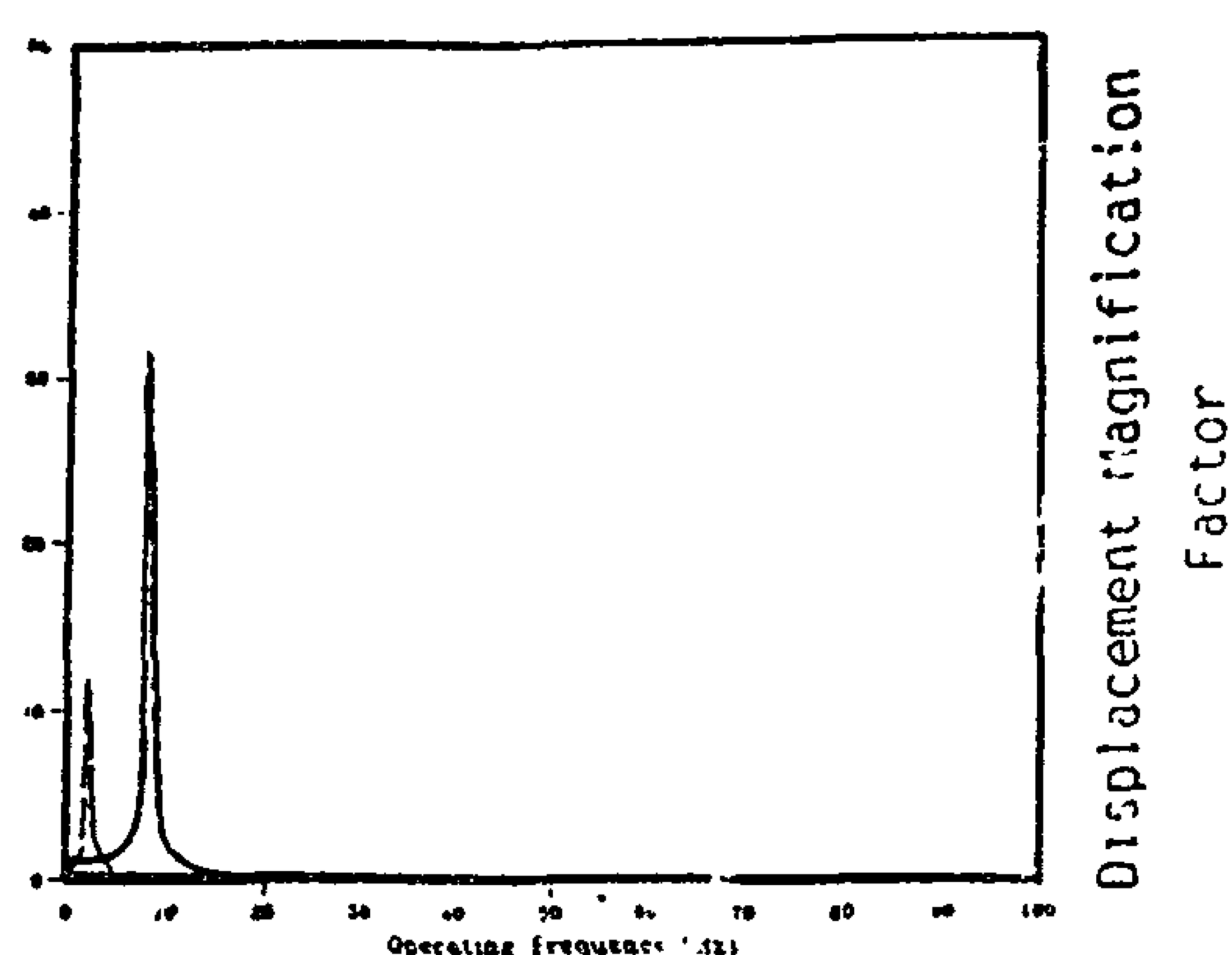
$W_{n\theta}$ = frequancy of torsional vibration.

Table 3.0 Summary of C.M.S. Results.

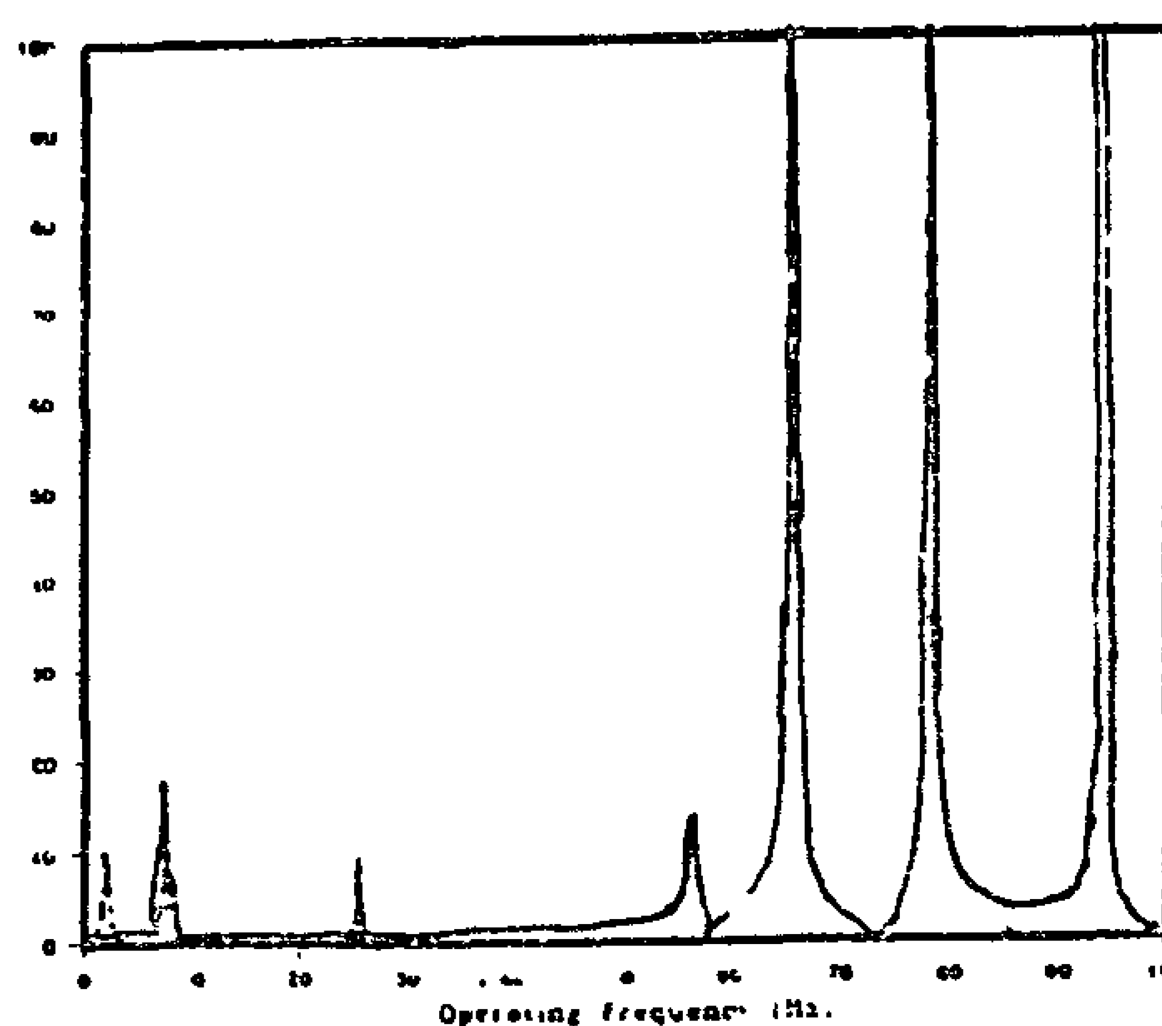
ITEM	NATURAL FREQUANCY		D. M. F.		DYNAMIC AMPLITUDE	
	(1)	(2)	(1)	(2)	(1)	(2)
Bent I						
Horizontal Vibration	9	9	0.0061	0.0052	1.676	1.512
Vertical Vibration	89	89	0.76	0.58	2.23	2.01
Rotation Vibration	74	70	0.235	0.044	1.31	2.29
Bent II:						
Horizontal Vibration	9.5	9.5	0.0084	0.0064	1.378	1.15
Vertical Vibration	85	83	0.316	0.043	1.067	0.192
Rotation Vibration	89	85	0.886	0.0784	1.052	0.226.
Bent III:						
Horizontal Vibration	10	9.5	0.074	0.006	1.152	1.037
Vertical Vibration	89	89	0.214	0.086	0.69	0.365
Rotation Vibration	88	84	0.468	0.0503	1.53	1.38
Longtudinal Bent:						
* Soil Effect is Ignored						
Horizontal	9.0		0.0058		1.334	
Vertical	9.0		0.206		0.598	
Rotation	9		1.178		0.733	
* Soil Effect is considered						
Horizontal	4.0		0.0011		0.174	
Vertical	4.0		0.00032		0.0498	
Rotation	3.0		0.0038		0.5999	

(1) No shear deformation

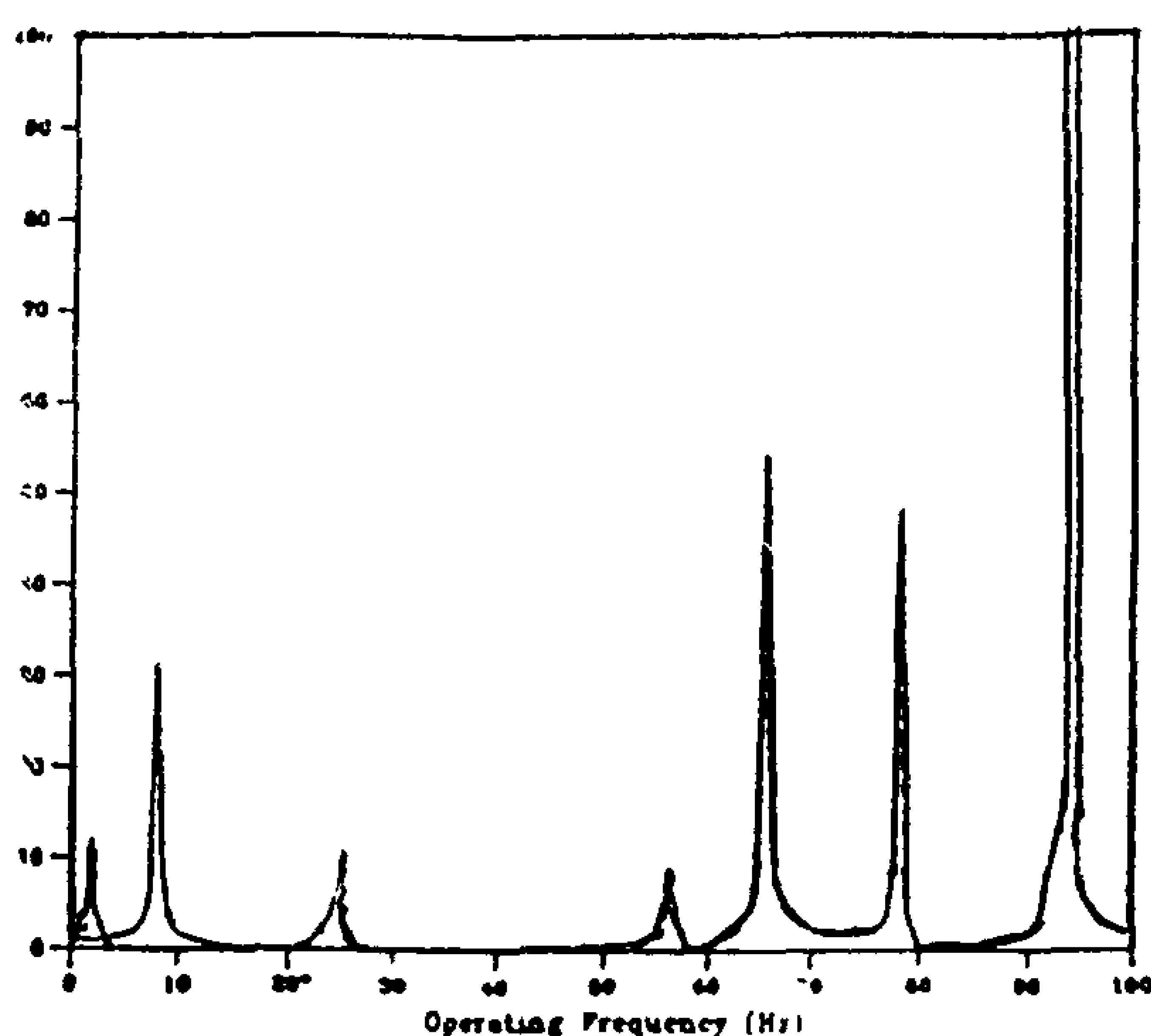
(2) Shear deformation considered.



Dynamic Response of the Pedestal - Node A-Horizontal



Dynamic Response of the Pedestal Node A-Vertical



Dynamic Response of the Pedestal - Node A-Rotation

———— top level only
— — — top level + soil

Fig. (6) Dynamic response of longtudinal bent using C.M.S.

Table 2.0 :

Item	(1)	(2)	(3)
* Bent I			
Horizontal Translation	9.27	0.0051	2,-
Vertical Translation	91.73	0.991	12,-
* Bent II			
Horizontal Translation	9.92	0.0091	2,-
Vertical Translation	85.99	0.777	9,-
* Bent III			
Horizontal Translation	9.91	0.0059	2,-
Vertical Translation	85.96	0.776	9,-
* Horizontal and Rotation			
Horizontal	9.92		4,-
Rotation	9.57		

(1) Natural Frequancy.
(2) Dynamic Magnitication factor.
(3) Peak to Peak Amplitude $_1$50 x (in)

The following conclusions can be made:

(1) Comparing the results of the cases where shear deformations are considered with the ones where it is ignored, it is evident that considering shear deformation, in this type of structures, would have a negligible effect on the overall structural behavior. Hence, for all practicale purposes shear deformations may be ignored.

(2) Considering the results of analysis of individual bents, in the transverse direction, both analysis approaches, i.e., L.M.S. and C.M.S., seems to produce fairly close results.

(3) Taking soil effect into consideration seems to have a significant effect on the structural response. Soil simulation reduces the natural frequency of the structure significantly. In the example presented in this article, this reduces the dynamic magnification factor as well as the peak to peak amplitudes of vibration. Therefore, it is recommended that soil effect should be taken in consideration.

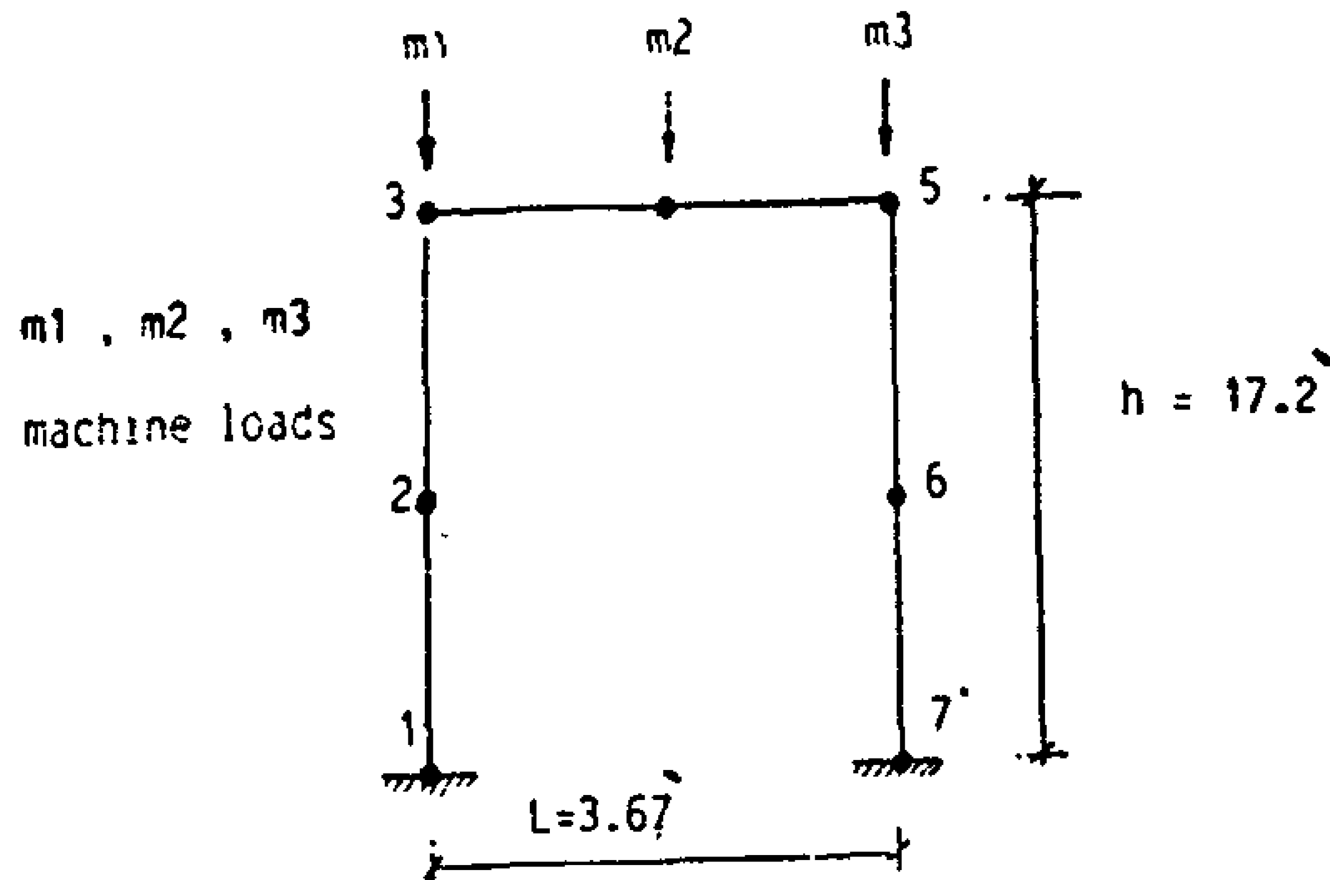


Fig. (4-a) F.E. discritization of transverse bents

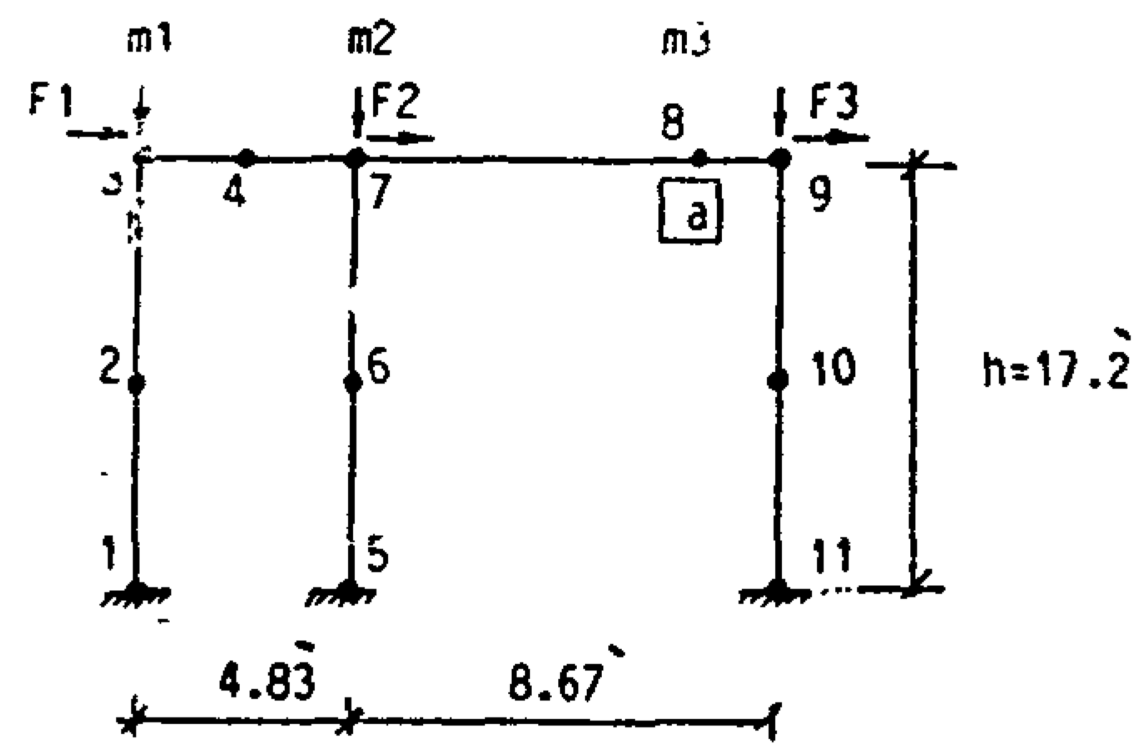


Fig. (4-b) F.E. Discritization of longtudinal bent ignoring soil effect

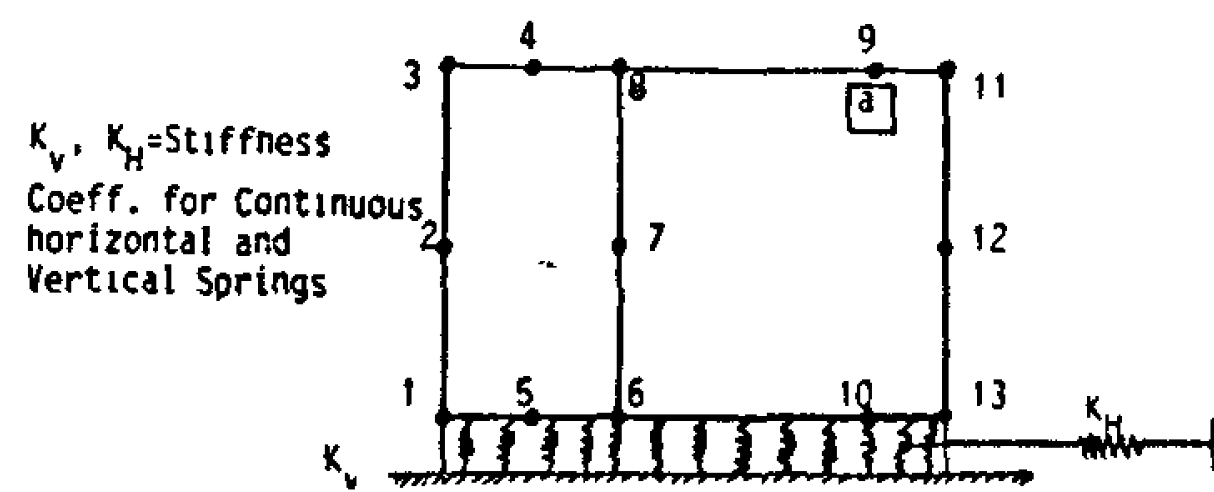
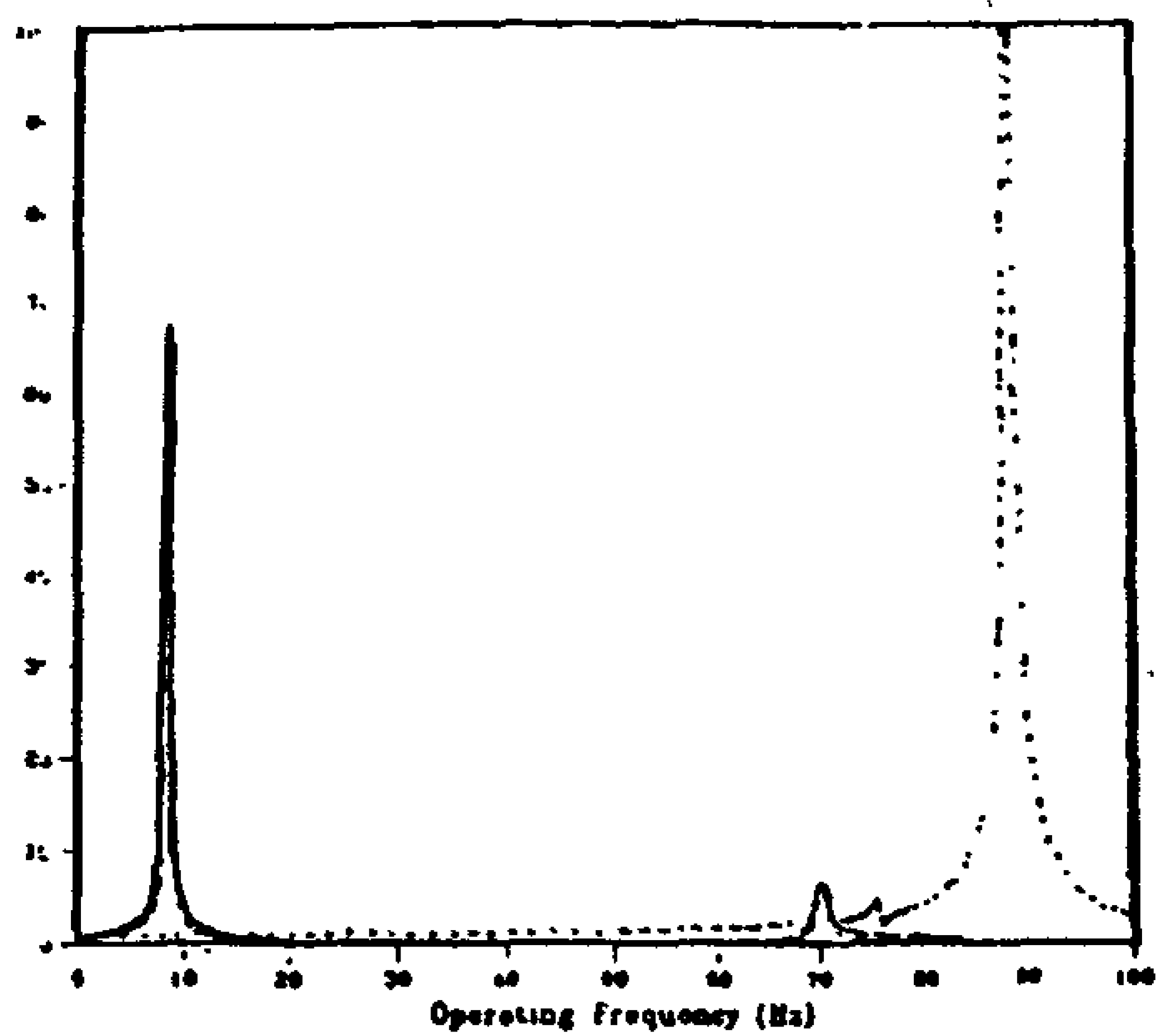
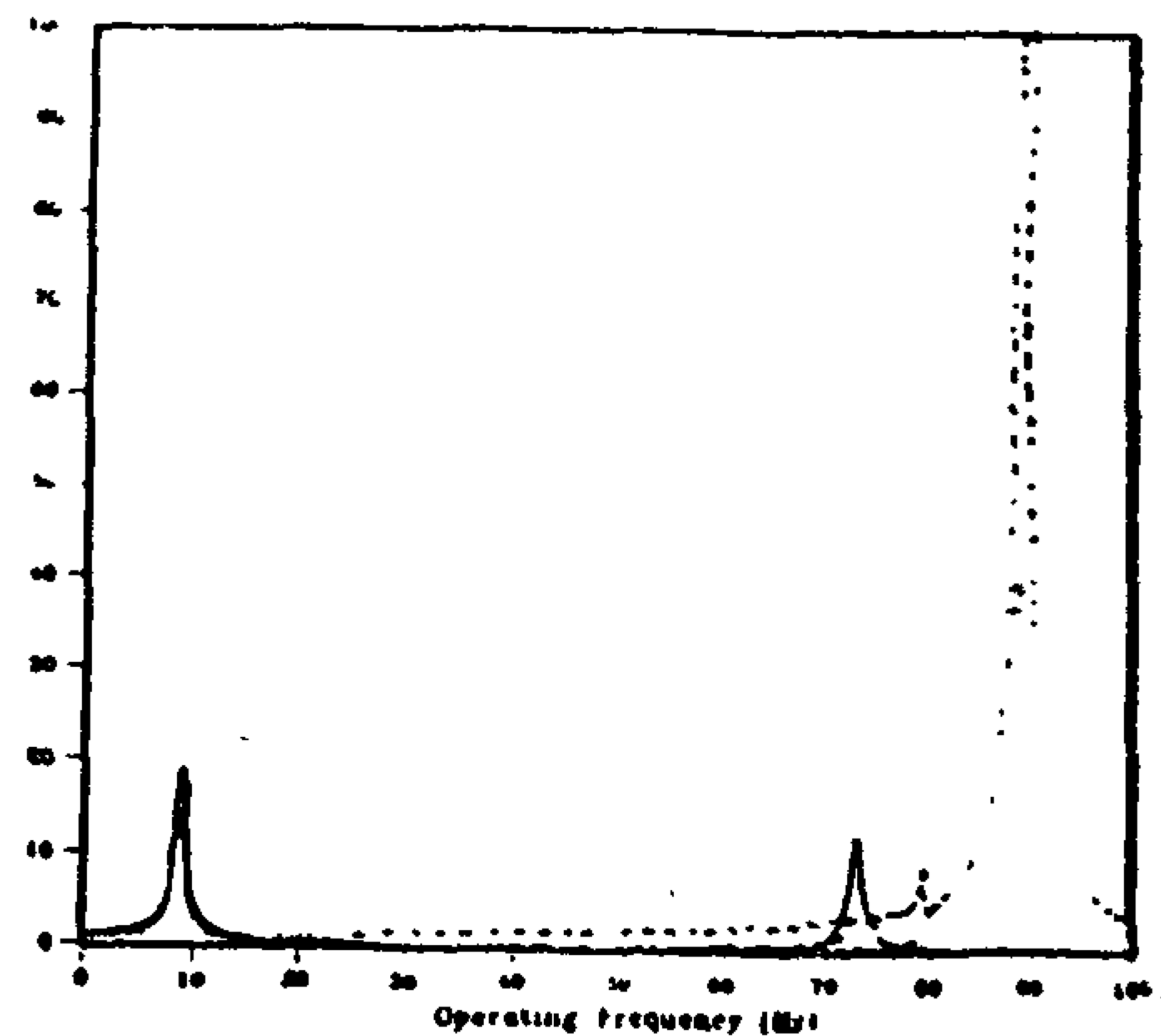


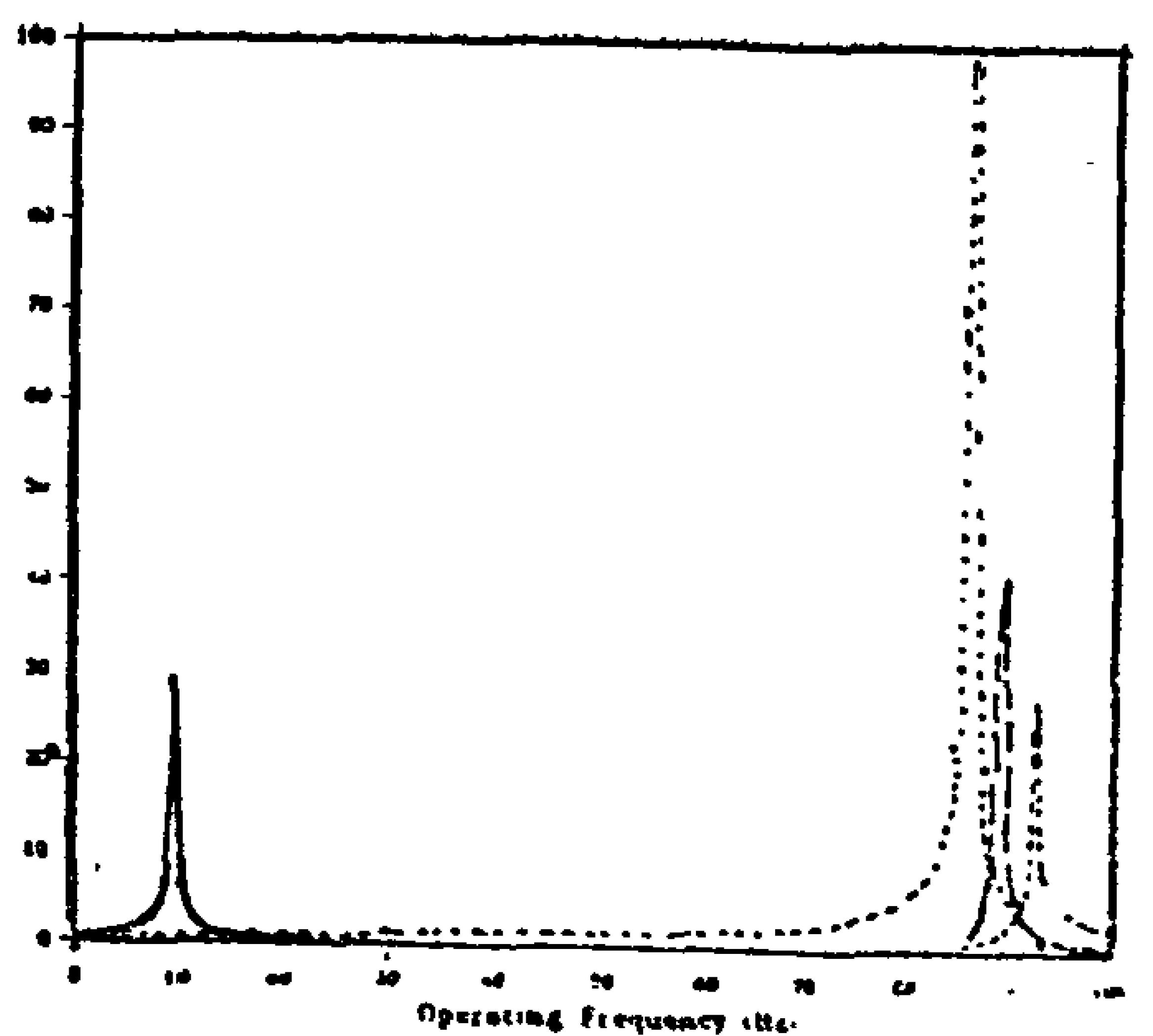
Fig. (4-c) F.E. Discritization og longtudinal bent considering soil vibration.



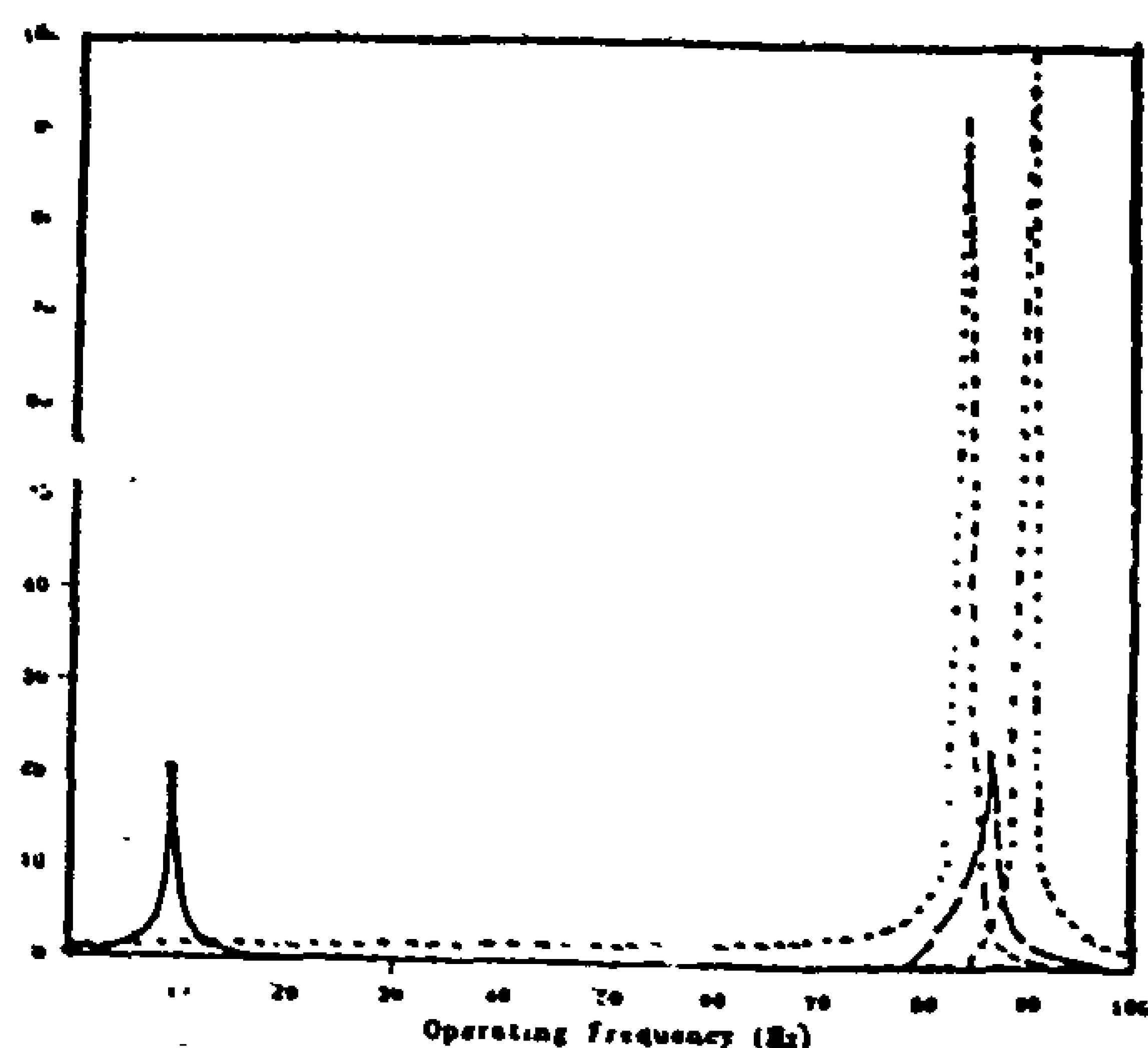
Dynamic Response of Bent I Taking Shear Deformations Into Consideration



Dynamic Response of Bent I Neglecting Shear Deformations



Dynamic Response of Bent II Neglecting Shear Deformations



Dynamic Response of Bent II Taking Shear Deformations Into Consideration

Fig(5) Dynamic Response of Transvere Bents

$$A_\theta = \frac{((e^2/r^2)W^2_{nx}.P - (W^2_{nx}-W^2_e).N.}{\Delta\,(W^2_e)} \quad (12)$$

where,

$$\Delta(W^2_e) = W^4_e - (\alpha W^2_{nx} + W^2_{n\theta}).W^2_e + W^2_{nx}.W^2_{n\theta} \quad (13)$$

$$P = \frac{\Sigma F_i}{\Sigma m_i} \quad (14)$$

$$N = \frac{\Sigma F_i.a_i}{\Sigma m_i.a^2} \quad (15)$$

For the case where $e = 0$,

$$A_x = \frac{\Sigma F_i}{\Sigma m_i (W^2_{nx}-W^2_e)} \quad (16)$$

$$A_\theta = \frac{\Sigma F_i.a_i}{\Sigma m_i.a_i^2 [W^2_{n\theta}-W^2_e]} \quad (17)$$

The total "peak-to-peak" amplitude of horizontal displacement becomes :

$$a = 2\ (A_x + a_i.A_\theta) \quad (18)$$

The special case of centres of mass, S, and centre of stiffness, E, being coincided results one mode only which is translation of the pedestal.

Consistant Mass System :

in this technique, the mass of the structural system is assumed distributed. A "finite Element" discritization is utilized to simulate the real structure To simplify the analysis, the structure may be analyzed as a 2-dimensional frame in both the longtudinal and transverse directions of the foundation.

Soil effect may be included. In this study winkler model was utilized to simulate the soil effect on the foundation behavior. Dynamic analysis is to be carried out for each bent considering the static loads acting on the bent as masses.

Shear deformations are considered while formulating, the element stiffness matrix. In this article a shear factor of 0.84 is considered.

Soil Model :

Raft is modeled as a beam on an elastic foundation. The stiffness matrix of this beam is formulated as follows :

$$[K'] = [K_o] + [K_w] + [K_a] + [K_t]$$

in which :

$[K_t]$ is introduced to ensure formulating a positive definite matrix and consequently the set of equilibrium equations could be solved. The values of $[K_t]$ are chosen arbitrarly as a ratio of $[K_w]$. Such ratio would have a negligible effect on the solution. In this case it is chosen 0.84. More details on this model may be found in Ref. [1].

Numerical Example :

To compare the results of numerical analysis using the previously discussed approaches, the structure shown in Fig. 1. is analyzed. The pedestal is divided in the transverse direction to 3 bents and in the longtudinal direction to tho bents. The distribution of the machine weight (given by the vendor) is as shown in Fig. 2.0 Using the common principles of structural analysis the weight of the pedestal is distributed along the supporting beams. The total loads acting on the beams are shown in fig. 2.

The results of the analysis using the [L.M.S.] are shown in table 2.0. This table presents the natural frequancies, dynamic magnification factors, and the peakto-peak amplitudes of different modes of vibration.

In Fig. 4, the F.E. discritization of a typical bent is shown. The results of dynamic analysis of the mid span node of the grider are shown in table 3. This node is equivalent to the L.M.S. solution. Typical results of the analysis are shown in Fig. 5.6.

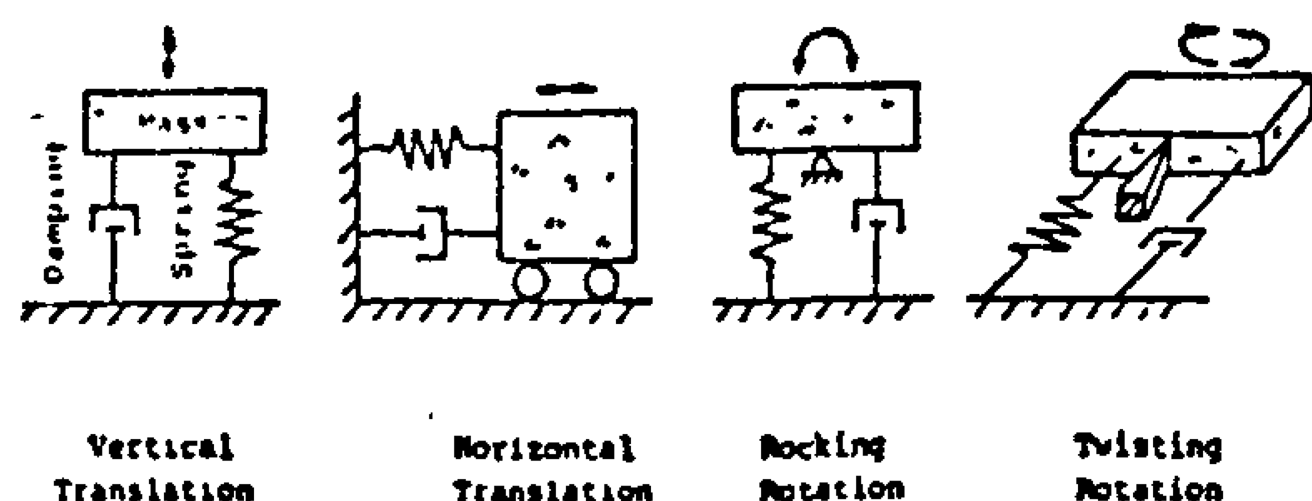


Fig (3-a) Modes of Machine Foundation Motion

a) Vertical Vibration :

,In this mode, the structure is discretized to three separate bents each is supporting the static loads of both machine and pedestal. The vertical deflection of the bent (Fig. 3. b)

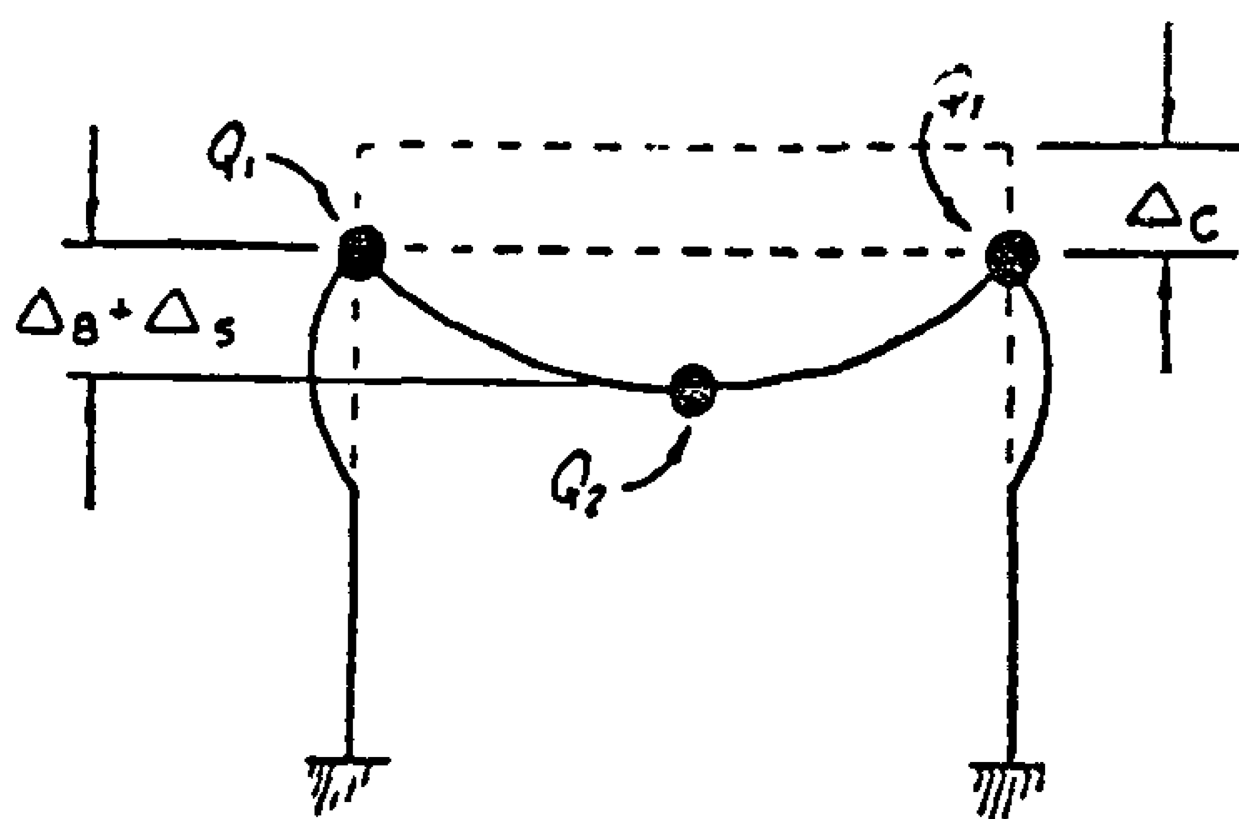


Fig. (3-b) Vertical Deflection of Bents

$$\Lambda = \Lambda_C + \Lambda_B + \Lambda_S \quad (3)$$

The natural frequency for each bent is defined as :

$$W = 3.12 \sqrt{\frac{1}{\Delta}} \quad \text{Cps} \quad (4)$$

b) Horizontal Vibration of Transverse Bents :

Each bent is subjected to a horizontal load equal to the load supported by the bent plus ½ the colum weight. Considering that the horizontal static deflection is (ΔH), the horizontal natural frequency may be calculated as in (4).

c) Translaation of the pedestal & Torsional Vibraation

The foundation should be checked against horizontal vibration in the transverse direction as a complete rigid body, (Fig. 3.c). Should the centres of mass, S, and stiffness, E, do not coin-

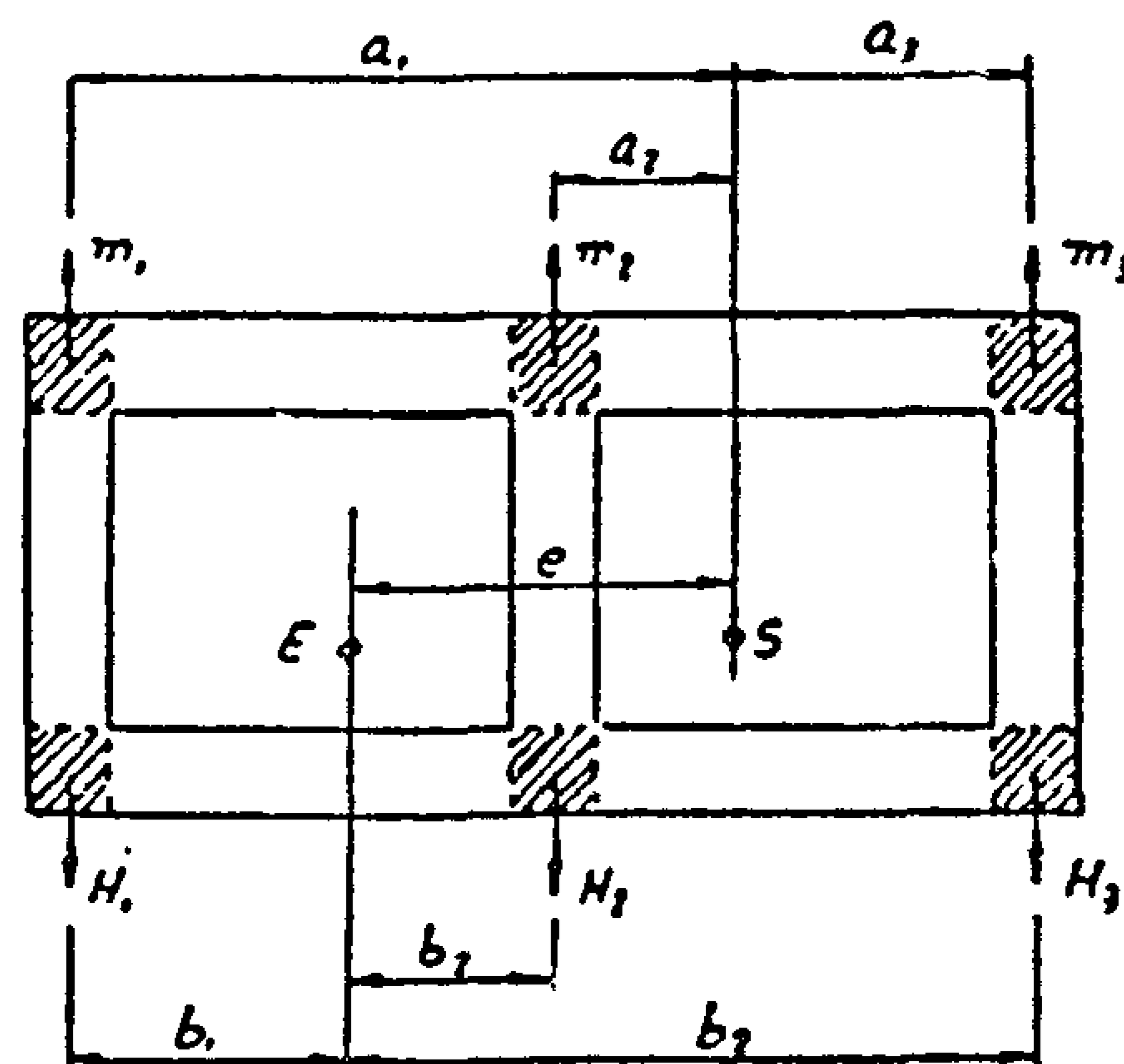


Fig. (3-c) Plan Showing Centres of mass & Centre of rigidity.

cide, which is the common case, rotation of the foundation around the vertical axis passing through the centre of stiffness will occur. This mode may be defined as "Torsional or Twisting Vibration". This general case, results two coupled modes of vibration; namely translation and torsional modes. It can be shown [2], that the natural frequencies are the roots of the following equation :

$$W^4{}_n = (\alpha W^2{}_{nx} + W^2{}_{n\theta})\, W^2{}_{nx} + W^2{}_{nx} \cdot W^2{}_{x\theta} = 0 \quad (5)$$

in which:

$$W^2{}_{nx} = \frac{\Sigma H_i}{\Sigma m_i} \quad (6)$$

$$W^2{}_{n\theta} = \frac{\Sigma H_i \cdot b^2{}_i}{\Sigma m_i \cdot a^2{}_i} \quad (7)$$

$$\alpha = 1 + e^2/r^2 \quad (8)$$

$$r = \Sigma\, m_i \cdot a^2{}_i / \Sigma m_i \quad (9)$$

The moment of the couple causing rotation

$$M = \Sigma f_i a_i \quad (10)$$

and hence, it can be shown, that the dynamic amplitudes are :

$$A_x = \frac{[(e^2/r^2) W^2{}_{nx} + W^2{}_{n\theta} - W^2{}_e] \cdot P - W^2{}_{nx} \cdot N}{\Lambda\, (W^2{}_e)} \quad (11)$$

of freedom depends on the number of nodes and the number of degrees of freedom per node. The element mass is distributed along the element length. Soil effect may be included.

Fig (1-0) Layout of Machine Foundation

In all the previous approaches, foundation is designed such that :

(1) $0.7\ W_m \geq W \geq 1.3\ W_m$ (1)

In such case, damping effect may be ignored since its effect on the dynamic magnification factor is less than 4% [2]

2. The total "peak-to-peak" amplitude of the structure for each mode of vibration should not exceed the values shown in table 1.0. ......

Table 1.0 .Speed of rotor VS. peak to peak Amplitade [4]

Speed of Rotor, rpm	Maximum Allowable Peak-to-Peak Amplitude, in.
0-999	0 0009
1000-1149	0.0008
1150-1299	0 0007
1300-1499	0.0006
1500 and above	0 0005

The peak-to-peak amplitude is as follows

$$Y = 2.A\ (static)\ (D.M.F) \quad (2)$$

To illustrate the fundamentals of each approach a typical foundation is analyzed (Fig. 1.0). The foundation is composed of three bents (Frames). The machine loads and foundation geometry are also shown in Fig. 2.0.

Pedestal equipment loads distribution

	MACHINE WT*	ROTOR WT.
B1	2.80K	-
B2	4.30K	-
B3	0.18K	-
B4	7.57K	0.300K
B5	7.57K	0.300K
B6	14.89K	0.261K
B7	14.89K	0.261K

Fig. (2) Machine data
* includes baseplate WT.

Lumped Mass Systems (S.D.F. & M.D.F.)

In this approach the modes of vibration are defined as follows : (Fig. 3.a)

a) Vertical vibration.

b) Horizontal vibration of transverse bents.

c) Translation vibration of the pedestal.

d) Torsional vibration of the pedestal.

DYNAMIC ANALYSIS OF ELEVATED MACHINES FOUNDATIONS

A. H. ANIS[1], M.S. ISSA[2],

M.M. EL MELIGY[3]

ABSTRACT

Machines foundations are commonly analyzed to simple approaches. Often soil effect is ignored. This however, may have a serious harmful effect on foundation behavior after construction leading to damage of connecting piping and in many cases to the machine itself.

In this article a comparison between simple lumped mass approaches and the consistant mass approach is presented. Soil effect is modelled by a winkler model.

The results demonstrate the serious effect the soil may have on the overall response of the structure. It is concluded that soil effect should be included in the analysis.

INTRODUCTION :

Machines on elevated foundations are commonly used in industrial facilities. The use of such type is dictated by the layout of machine piping. A typical foundation is shown in Fig. 1.0. Successful design of such type of construction necessitates both static and dynamic analyses of the foundation. While the first form of analysis is well established and documented, the latter analysis is still subject to modifications of approaches in order to reach a simple and yet realistic approach for analysis and design of such foundations. The objectives of dynamic analysis are to produce a foundation with a natural frequency significantly different from that of the driving machine. This in turn should result a relatively small dynamic magnification factor as well as small dynamic displacement.

In this article, a comparison between several approaches of structural discretization is presented, which are :

[1] Single Degree of Freedom [S.D.F.] System :

In this system, the structure is modelled as of a lumped mass. All modes of vibrations are assumed uncoupled. Soil vibration is ignored.

[2] Multi-Degree of freedom [M.D.F.] System :

The structure is still assumed to be of a lumped mass. However, some modes of vibrations are assumed coupled (e.g., vertical and rocking modes, Horizontal and torsional vibration modes etc.). In this model, soil effect may not be considered in the analysis.

[3] Consistant mass System [C.M.S] :

The structure is discretized to several finite elements. The number of degrees

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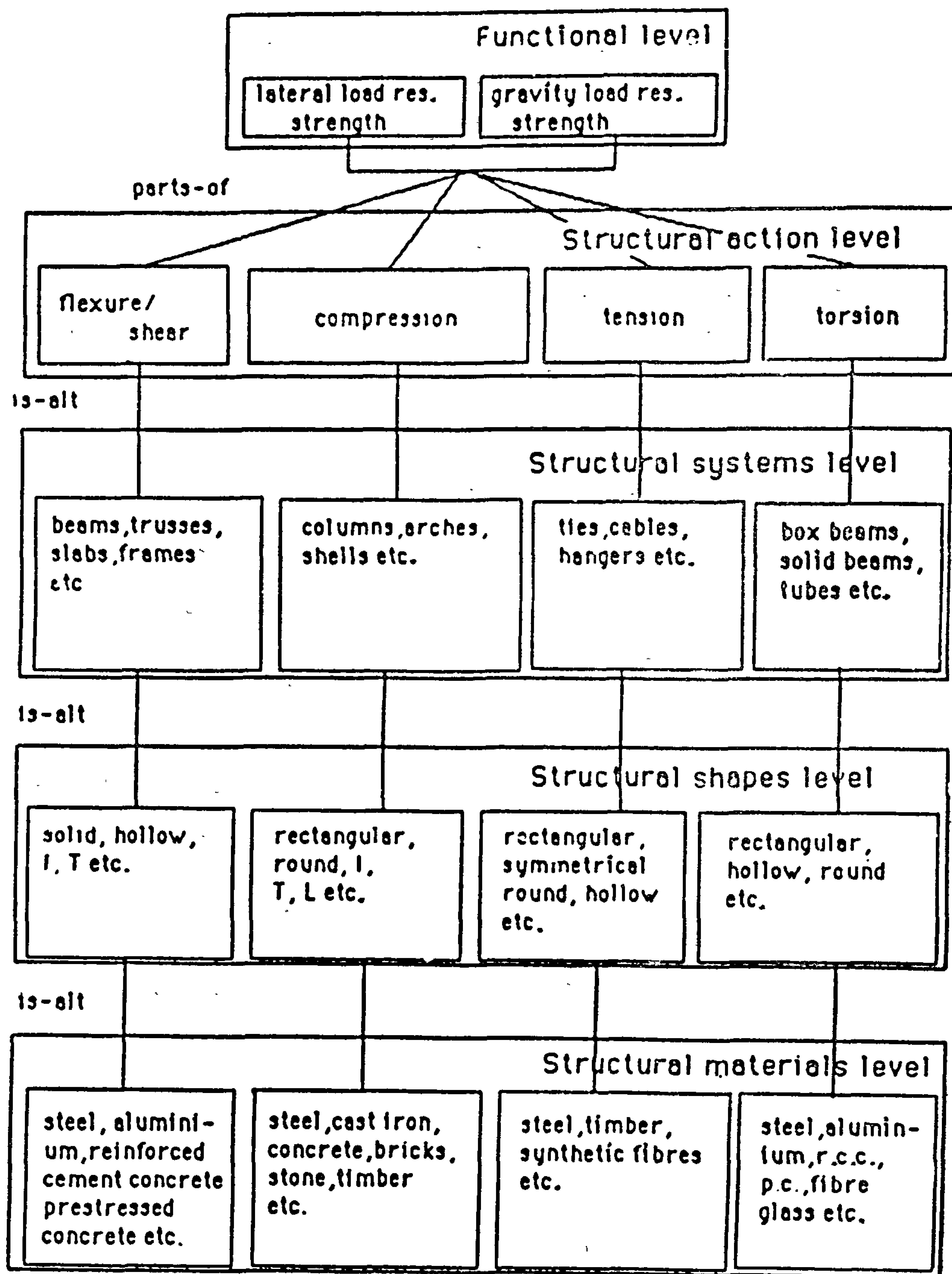


Figure 2. Abstraction hierarcy of struc-tural design entities. after [13].

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ferent knowledge-modules communicating through the blackboard. The space planning is carried out in the domain of architectural design, i.e. before utilized after the general layout of the building has been fixed. In other words, the system takes the general layout and other spatial constraints of the building as its input. Since the layout of the design is fixed, the domain of the system is therefore restricted to structural design. The blackboard is divided into two main parts, the problem definition (input by the user) and the knowledge base. The knowledge base modules are organized into a hierarchy of the two levels, the specialist level and the resource level. The specialist level consists mainly of heuristics, rules of thumb that are mainly specialist dependent (i.e. meta-rules or shallow knowledge). The resource level consists mainly of textbook knowledge (i.e. domain-rules or deep knowledge). All the knowledge modules contain declarative (symbolic) as well as procedural (numeric) knowledge. More description of the knowledge modules can be found in [13].

REPRESENTATION OF STRUCTURAL DESIGN ENTITIES :

Representation of any piece of information basically involves the determination of the levels of abstraction of the object under consideration. Abstraction may be seen as a simplified model of a complex object in terms of specitcation and products. Each level in the abstraction hierarchy may be seen as a set of specifications for the next level and the product of the previous level. Kumer et al. [13] proposed an extensive domain independent abstraction hierarchy levels for structural design entities for a general system, as shown in figure 2. The abstractioon hierarchy shown in figure 2 can be seen as a modular organization of the knowledge required for any structural design. This organization covers almost the whole domain of structural design. However, this organization would not only require a very considerable storage capacity, but would also need very afficient knowledge representation formalisms which is not available with the present state of knowledge-based systems technology.

CONCLUSION:

It appears now that Knowledge-based Expert systems serve mainly as a pool of accumulated knowledge and experience relevant to a particular domain. Because of the need to deal with logic, represented in symbols, for the development of these systems, they do require different program design concepts and tools. Development of a Knowledge-based Expert System KBES may take few months, however the complete development and maintenance may take years. The system builder (the Knowledge engineer) better have reasonable background in the domain for which he is developing the system and in Artificial Intelligence techniques as well. Applications of KBES in structural engineering, although still limited, seem promising since the problem-solving behavior of a good experienced structural engineer differs by far from that of a newly graduate engineer.

APPLICATIONS IN STRUCTURAL ENGINEERING :

Application of AI in computer-aided design of structures is a recent development. In a pioneer paper, Fenves and Norabhoompipat [15] discussed potentials for AI applications in structural engineering. Researches have been conducted on large scale design (i.e. considering the whole design process in structural engineering) and on small scale design (i.e. considering the design process of only some structural components). Examples of The AI in small scale design can be found in References 16 to 20. They all use a feedback mechanism consisting of three steps : acquisition of experience, application of experience, and database management. In large scale design problems, a number of applications with different directions have been reported in the recent literature. More information on works in progress regarding expert systems in structural engineering can be found in References 7 and 24. The general layout of an expert system for the use on large scale designs is discussed next.

The structural design process starts with the definition of a need to transmit loads in space to a foundation subject to some engineering, architectural and financial constraints. The whole design process of the structure can be viewed as a sequence of three stages [12,13,24] :

1. Conceptual design : involves the selection (synthesis) of a potential structural configuration satisfying layout and a few constraints. Usually, one, or at most very few, systems are selected to pursue further. This stage requires a knowledge of the main structural subsystems and their appropriateness for different situations.

2. Analysis : involves transforming the selected physical structural system to a mathematical model, analyzing the model and interpreting the results in terms of the actual physical structure.

3. Detailed design : involves the selection and proportioning of the structural components to satisfy all applicable constraints.

During Conceptual design, the form of the design solution is identified. During analysis and detailed design this form is refined. Usually the final (optimum) design of the structure is achieved after a number of cycles (back and forth) between conceptualize, analyse, and detailing stages.

During the conceptual design of a structure, the only information available to the designer are the specifications of the end product. It is during this part of the whole design process that creativity and experience are needed. Although designers should think in an overall way, concentrating on the relationship between spatial forms and structural systems and ignoring trivial details, they should also be able to distinguish the details which must be considered before the properties of the whole system can be well established. For that reason, good designers should be knowledgeable about architecture and structures and also have experience that enables them to make correct judgements as easily as possible to avoid major conflicts later in the design process.

Conceptual design is achieved by synthesizing potential alternative designs. There is no standard approach to do so. [12]. In design of residential and commercial buildings, Sriram [14] proposed a conceptual model for integrated structural design called DESTINY. It integrates all the stages of the structural design process into an unified framework. This model is slightly changed when applied by Kumar et al. [13]. for the design of industrial buildings. The model uses a blaackboard system. It consists of dif-

rove the efficiency of the search. A few of the search strategies used to improve efficiency are depth-first versus breadth-first searching, problem-reduction, and the alfa-beta algorithms [8].

KNOWLEDGE ELICITATION :

The final issue to be addressed is that of actually acquiring the knowledge and putting it into the knowledge base. The problem should be broken down, as much as possible, into several small subproblems. The knowledge engineer needs to listen to the expert to determine where this partitioning to be done. The engineer also needs to determine the basic strategies used by the expert in approaching and solving the problem. The acquisition process is cyclic rather than linear, and is less structured than any part of the knowledge design. The engineer will first obtain as much knowledge as possible on a particular module or part of the system. This part of the knowledge base is then tested, and both the expert and engineer can expect major limitations at this point. The knowledge base is then modified, expanded, then tested again. This process continues, with the system gradually increasing in its capability [10]. Besides difficulties in developing the system, Knowledge engineer may face some difficulties in dealing with domain expert, at least at the beginning. An interesting experience in that line is reported in Reference 10.

Another class of knowledge elicitation is machine induction, in which the computer induces rules from examples automatically. This necessitates the availability of sufficient examples to construct a training set which constitutes a comprehensive encapsulation of expertise in the domain. Generally, machine induction is not suitable for elicting knowledge in structural engineering since it can not be completely encapsulated in examples.

LANGUAGES USED IN EXPERT SYSTEMS DEVELOPMENT

The key of the programming approach is the programming language used. Logical relationships are always used by experts to express their expertise, rules of thumb, heuristics and engineering sense. FORTRAN and BASIC (and alike) languages do not handle logic relationships efficiently. The most common known AI languages used to develop expert systems are LISP and PROLOG. LISP is short for List Processing which means it works by processing items on lists that are linked in some way. One of the basic features of LISP is that everything in the program, even basic instructions, is treated as an element or item of data on a list [5]. PROLOG is short for Programming in Logic. It is a computer language that was created especially for answering questions about a knowledge base that consists of rules and facts [22]. The applicability of other tools, such as OPS5 and SRL, in conjunction with either LISP and PROLOG is discussed in Reference 24

SELF EXPANDABILITY OF KNOWLEDGE-BASED SYSTEMS :

Self expansion capability of expert Systems can be seen in two directions. The first is expanding the data bank of an Expert system by back-feeding the data bank with the new designs, carried out by the system, every time the system is confronted with a new design. This is the case with most systems containing a databank in their structure. The second way of containing self expansion capability in an Expert Systems is by teaching the system new rules about the domain so as to improve its performance. The achievement of this goal is limited by the ability of the programming language, used in the system, to produce and/or induce new rules. For instance, PROLOG does not handle such problem efficiently.

IF section compact, AND
Not hybird grider or made of
AS 41 steel.
THEN allowable stress in bending
Fb = 0.»6Fy

* In stress behavior
IF The material composing the substructure is one of : the materials.
AND, the analysis error in percent, that is tolerable is between 5 and 30
AND, the non-dimensional stress of the substructure is greater than 0.9.
AND, the number of cycles of the loading to be applied is between 1000 and 10000.
THEN it is definite (1.0) that fatigue is one of stress behavior phenomena in the substructure.

Such knowledge, represented in domain rules are termed "deep knowledge" in AI terminology [2.8].

Meta rules : (rules about using domain rules) these rules are usually provided by experts and depend on experiential knowledge that comes from having successfully solved a lot of problems. For instance, using hybrid or a non-hybrid grider in steel design, using prestressed concrete or reiforced concrete in design of a specific concrete grider span is a kind of decision to be provided by an expert designer. This type of knowledge is often called shallow knowledge.

INFERENCE MECHANISM

A number of different heuristic problem-solving paradigms are available in AI literature [8]. In rule-based problem solving (production) system, as explained above, a collection of IF/THEN rules (i.e. the knowledge base) are used. These rules work on a database (or the working memory provided by the user), using a controlling strategy or rule interpreter (called inference engine) by employing one or more controlling mechanism (called inference mechanisms). The inference mechanism fires (executes) rules according to its built in reasoning process. The inference mechanisms available are [5,7,8]

1. Forward reasoning : (data-driven control strategy).

In this reasoning mechanism, rules are scanned until one is found whose antecedents match the given information of the problem entered by the user. Once found, the rule is applied and database (working memory) is updated. This process is repeated until the goal state is achieved or no usable rule is found. This approach is usually useful when only small number of initial conditions are available.

2. Backward reasoning : (goal driven control strategy).

In this strategy, rules are scanned and those whose consequent actions can lead to the specified goal are found. For eaach of these rules a check is made to see whether its antecedents match the information of the problem entered by the user. If they all match, the rule is applied and the problem is solved. If there exists an unmatched antecedent, a new subgoal is defined as "arrange conditions to match that antecedent". This process is applied recursively. This approach is usually useful when a small number of possible solutions exist.

3. A combination of both forward and backward reasoning.

This is called cyclic search strategy. In structural design since possible goal states cannot be easily represented, a combination of the two approaches together, with dividing design process into design subtasks, seems to be the most appropriate control strategy [7].

With any of the control strategies discussed above, it is often advisable to implement strategies to minimize or imp-

d) Data base:

It contains computational procedures (algorithms) relevant to the particular domain

e) Inference engine:

Is the component that controls the selection of rules from the knowledge base as a function of available information to derive a conclusion. The inference engine acts as the executive that runs the expert system. It fires (executes) rules according to a built-in reasoning protocol, hence performs actions that lead to solution of the problem and at the same time, may change the knowledge base by adding new knowledge to it.

f) Knowledge acquisition:

Is the process of obtaining information and expertise from individuals familiar with the problem to be solved. This process is often automated with the aid of the computer using libraries, data bases and the feed back of knowledge elicitation techniques.

A distinguishing feature of an expert system is the separation of the control strategy (inference engine) from the knowledge base. The control mechanism (strategy) determines the overall order of problem-solving activities, such as which rule to examine next and what questions to ask the user. The separation of knowledge from control makes it possible to change the knowledge base (e.g. by adding new rules, to update it for instance) without having to rewrite other portions of the program. This is a great convenience and a sharp contrast with conventional programs in which the code must often be revised extensively when new rules are introduced[6].

In developing a knowledge based expert system, the following issues should be addressed:

— How the knowledge be presented?
— What inference mechanism to be used?
— How the knowledge be elicited?

These issues are briefly discussd hereinafter.

REPRESENTATION OF KNOWLEDGE:

Several approaches for representation of knowledge are available in the AI literature including: mathematical logic, predicate logic, semantic networks, frame and production sysems [8]. The production systems and the frame systems appear to be the most suitable representation approaches for expert systems in the area of structures[7]. Only the production system (rule-based system) is considered here.

The rule-based representation consists of IF (antecedent) ... THEN (consequent with certainty factor C). The production rules facilitate the generation of explantion facility because IF/THEN (situation/action) rules can easily be transformed into questions. The general form of the rule is:

IF (antecedent 1), ... (antecedent n)]
THEN [(consequent 1 with certaintyC1),
(consequent 2 with certainty C2),
.... 3 .... C3),
.... n .... Cn)]

The rule number is unique for identifying the rule. Certainty factor indicate the level of confidence in a piece of information (not a propability). In structural engineering, two types of rules may be identified; domain rules and meta rules

Domain rules: these rules are usually formulated by employing design specifications. Examples:

* In steel design:

IF actual stress f $\leq$=allowable stress F
THEN stress constraint satisfied.

programs. A concise definition of an expert system has been given by Brachman et al. [2]:

> An expert system is one that has expert rules and avoids blind search, reaasons by manipulating symbols, grasps fundamental domain principles, and has complete weaker reasoning methods to fall back on when expert rules fail and to use in producing explanations. It deals with difficult problems in a complex domain, can take a problem description in lay terms and convert it to an inernal representation appropriate for processing with its expert rules, and it can reason about its own knowledge (or lack thereof) especially to recoust ruct inference paths rationally for explanation and self-justification.

BASIC STRUCTURE OF AN EXPERT SYSTEM:

The basic structure of an expert system is shown in figure 1 [2,4,5,23]. These components are briefly described as followes:

a) User interface:

Allowes the user to communicate with the system and to create and use a data base for the specific case at hand. This component is often associated with a high degree of user friendliness.

b) Explanation facility:

It represents the process though which the logic and rule base of the system is presented to the user. This facility provides the user with insight into the interpretation of the results and conclusions of the system. The user can ask how a certain hypothesis is deduced and why a certain question was asked.

c) Knowledge base:

It contains the basic knowledge of the domain. It is typically represented in the form of rules facts, beliefs and heuristics unique to expert and are always structured for the purpose of either diagnosis or consultation.

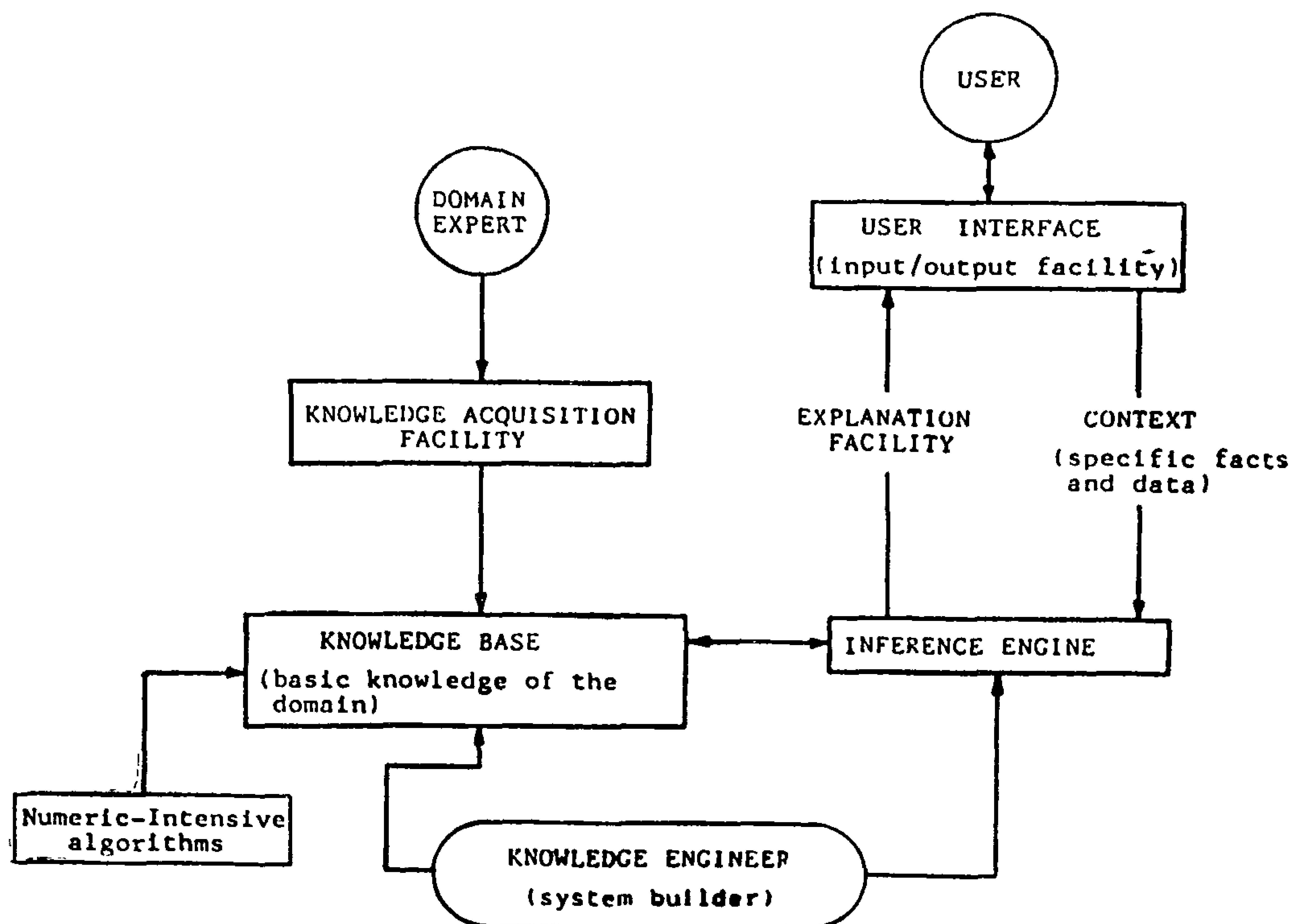


Fig. 1, Basic structure of an Expert System.

EXPERT SYSTEMS: INTRODUCTION AND APPLICATIONS IN STRUCTURAL ENGINEERING

Nabil A.B. Yehia*

ABSTRACT:

An overview of the Knowledge-Based Expert Systems is presented. A brief description is given for the main components of Expert system, knowledge representation, inference mechanisms and elicitation of knowledge from experts. Application of Knowledge-Based systems in structural engineering are discussed through two examples.

INTRODUCTION :

The roots of expert systems (or KBES: Knowledge-Based Expert Systems) lie in the field of artificial intelligence, the science that mainly tries to emulate the human thought processes. Conventional computer programs consist of sequentially executed rules in the form: IF (condition) THEN (action). The overall model of any program is IF input THEN compute where compute module is usually containing more single IF ... IHEN rules. The easy part of writing a conventional program is to identify the relevant conditions to formulate the appropriate actions for each condition based on the available knowledge of the particular field. The most difficult part of programming is to decide in advance the fixed sequence in which the rules will be executed and to assume that the resulting program is complete and correct, [1]. Therefore, conventional computer programs can be viewed as ones where the sequence of testing and applying, the rules is determined in advance and where each rule premise leads to one, and only one, action. In other words, progress of such programs is controlled by a tightly knit algorithm.

Expert systems are defined as computer programs that use logical relationships to incorporate knowledge and expertise about a specific problem area to perform specialized tasks that typically require judgment. Successful applications in civil engineering has occurred when other computer approaches have been unable to incorporate traditional rules of thumb that are common in decision making. In an expert system, the sequence of testing and applying rules (IF/THEN rules representing an expert's problem solving knowledge) is determined within the program by a control strategy. The rules premises may lead to multiple actions or no action at all. Both the rules (knowledge base) and the control strategy (inference engine) may incorporate heuristics, rules of thumb that are accumulated by an expert after years of problem solving, the thing which enables expert systems to provide advice, answer questions and justify their conclusions. This is often termed: transparency, which refers to the ability of the user to stop the program in the middle of a run in order to learn about the reason behind the prompt or conclusion made by the program [7,11]. For this capability to be available, expert systems have to be highly user interactive, which need not be the case in conventional

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(2) Frictional forces acting on the piping system often are ignored in refinery piping or considered of a secondary nature. However, in trunk lines and due to the long span of the expansion loops, frictional forces should be considered as primary forces.

(3) Friction forces have vital effect on the pipes movement. Frictional forces due to the weight of production lines overcome the expansion forces. Hence, a virtual anchor is created along the loop legs causing increase of the expansion stresses and pipe movement opposite to the movement anticipated in regular expansion loops.

(4) The time lag between steam injection and heating production lines should be considered. This affects the spacing permitted between steam and production lines. This time lag was the primary cause of collision between the two systems of piping. Spacing between piping should account for expansion of the two systems independently.

Accurate evaluation of pipe movement is very essential in order to avoid pipes falling off the support. At the supports of the 45° legs of the loop, an extra long shoe had to be used to ensure that pipes would remain on the support. Orientation of these supports was determined based on actual pipe movement.

(5) Steam piping behaves in two independent manners. At high temperature, expansion forces overcome the frictional resistance hence the loop behaves in a conventional manner. At moderate temperatures, virtual anchor may be formed, due to friction, at mid span of the loop causing the loop behavior to change dramatically from that of the first case. This finding could only be found by using non-linear incremental analysis.

ACKNOWLEDGEMENT :

Wolf lake project was designed in 1981 Delta projects LTD of calgary was the E.P.C contractor. The help of Delta stress and civil departments in performing this work is gratefully acknowledged.

NOTATION :

F : Frictional force

μ : Cofficient of friction.

W : Pipe weight including commodity.

N : Contact force normal to the direction of movement.

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Table 4. Effect of Coefficient of Friction on Max. Calculated Stress

Pipe size	Expansion span (L)	Loop Depth (h)	Coeff. of friction	max. Stress (Ksi)	Allowabk stress (ksi)	Actual/ Allowable stress
6"	1040	30	0.4	54.0	26	2.0
6"	1008	30	0.35	39.7	26	1.52
6"	1040	30	0.1	25.8	26	0.99

Table 5. Summary of Analysis of STEAM Lines

Diameter	node numb	Coefficient of friction	Temp	Nodal Movement X (in)	Y (in)	Loop sizes L	h	Max Stress (ksi)
12"	1		100	3 94	2 88	1092	46	
			400	16 13	1 76			
		0.40	700	28 34	-3 2			44.5
	2		100	-0 34	-2 22			
			400	-1.29	-19 02			
			700	-2 25	-39 75			36.5
12"	1		100	3 98	1 21	1052	46	
			400	16 17	-2 63			
		0 35	700	28 38	-8 73			35.04
	2		100	15	-3 76			
			400	-0.61	-22 83			
			700	-1 07	-44 24			41 28
8"	1		100	3 93	1 72	1016	33	
			400	.16	-2 63			
		0.35	700	28 08	-10 10			39 8
			100	-0 14	-2.94			
			400	-0 57	-21.67			
			700	-1.21	-43.5			38.0
6"	1		100	2 63	1.91	1004	30	
			400	10 64	1.03			
		0.35	700	18.66	-2 76			32.885
	2		100	-0.16	-1 42			
			400	-0.64	-12.43			
			700	-1.13	-26.39			29.14
6"	1		100	3.94	2.82	1038	30	
	2	0.1	400	15.87	-5.62			
	3		700	27.79	-13.07			27.822
	1		100	-0.33	-4			
	2		400	-1.30	-25.05			
	3		700	-2.28	-47.13			15.37

CONCLUSION :

The main conclusions of this study are :

(1) Trunk lines piping can be classified as petroleum refinery piping and hence should be designed according to ANSI B 31.3 (7). Steam piping subsequent to the first valve from the boiler house does not fall under the Jurisdiction of B 31.1 (6). Hence, for an economical design of the piping system, steam piping may be designed to B 31.3(7).

efficiency. The two systems were designed such that during all loading stages collision is avoided.

Anchor loads at intermediate loops balanced themselves. However, special attention must be given to the forces acting on anchors at the runs ends. This force should be safely transmitted to the ground. Due to the long length of the expansion loops, this force is normally very large .In this project special bracing had to be designed to transmitt this anchor force to the ground.

The behavior of the production system may be altered significantly by reducing the coefficient of friction between the pipe shoe and the support. This may be achieved by using steel faced, TEPHLON' plates. In this case friction coefficient may be reduced to 0.1 instead of 0.35. This however should be considered in view of its cost.

Table 3. Calculated Nodal Displacements of Production Lines

Pipe size	node number	Coefficient of friction	Temp. (F)	Movement (in) X	Y
10"	1		50	1.47	1.51
L=1046'			200	6.82	4.50
		0,35	400	13.95	6.27
h = 46'			50	-0.06	-0.38
	2		200	-0.23	-3.99
			400	- .45	-11.05
8"	1		50	1.47	1.08
L=1022'			200	6.76	2.79
			400	13.81	3.50
h = 40'	2	0.35	50	-0.06	-0.56
			200	-0.22	-4.88
			400	-0.44	-12.5
6"	1		50	1.46	1.33
L=1040'			200	6.65	5.38
		0.40	400	13.58	9.75
h = 30'			50	-0.15	-0.53
	2		200	-0.32	-2.51
			400	-1.13	-6.94
6"	1	0.35	50	1.51	1.60
L=1008'			200	6.77	4.48
			400	13.76	4.88
h = 30'	2		50	-0.08	-0.22
			200	-0.27	-3.49
			400	- .54	-11.25
6"	1	0.1	50	1.67	1.38
L=1040'			200	6.88	2.42
			400	13.86	0.06
h = 30'	2		50	-0.14	-0.68
			200	- .50	-6.0
			400	- .95	-16.90

ner different from that of the conventional loop, Fig. 5.a This resulted an increase of the thermal stresses at the loop elbows and deformation opposite to that expected in conventional loops. It was evident that simplified analysis in which frictional forces are ignored would produce gross errors in both max. stresses and deformations.

Table 2. Summary of Design Parameters of the Designed Pipes

Pipe size (in)	Type	Design Parameters		
		Temp.F	Coeff.of friction	Bent radius/diameter
12"	steam	700	0.35	1.5
8	steam	700	0.35	1.5
6	steam	700	0.35	1.5
6"	steam	700	0.1	1.5
10"	production	400	0.35	1.5
8		400	0.35	1.5
6		400	0.40	1.5
6		400	0.35	1.5
6		400	0.1	1.5

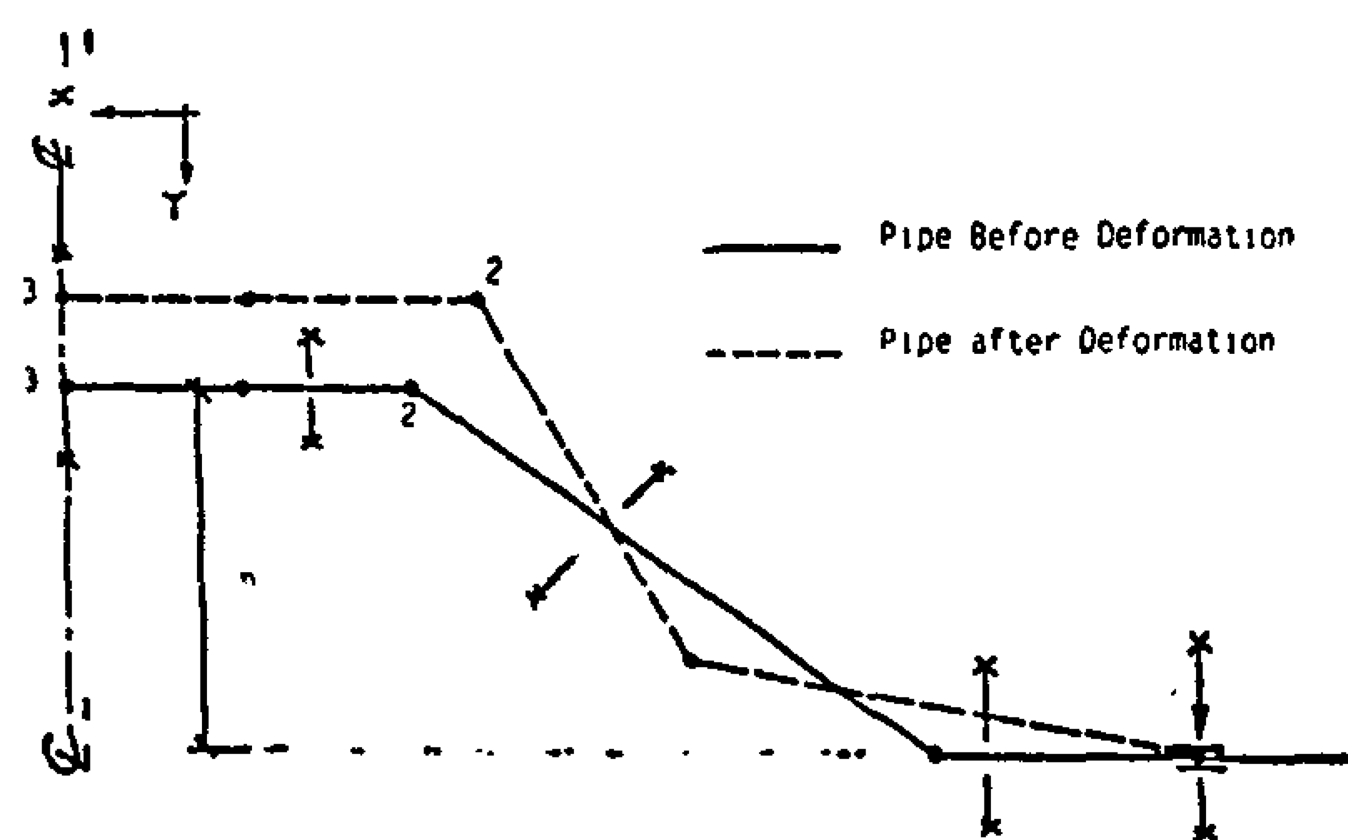


Fig. 5 a) Deflected Shape of a Conventional Loop

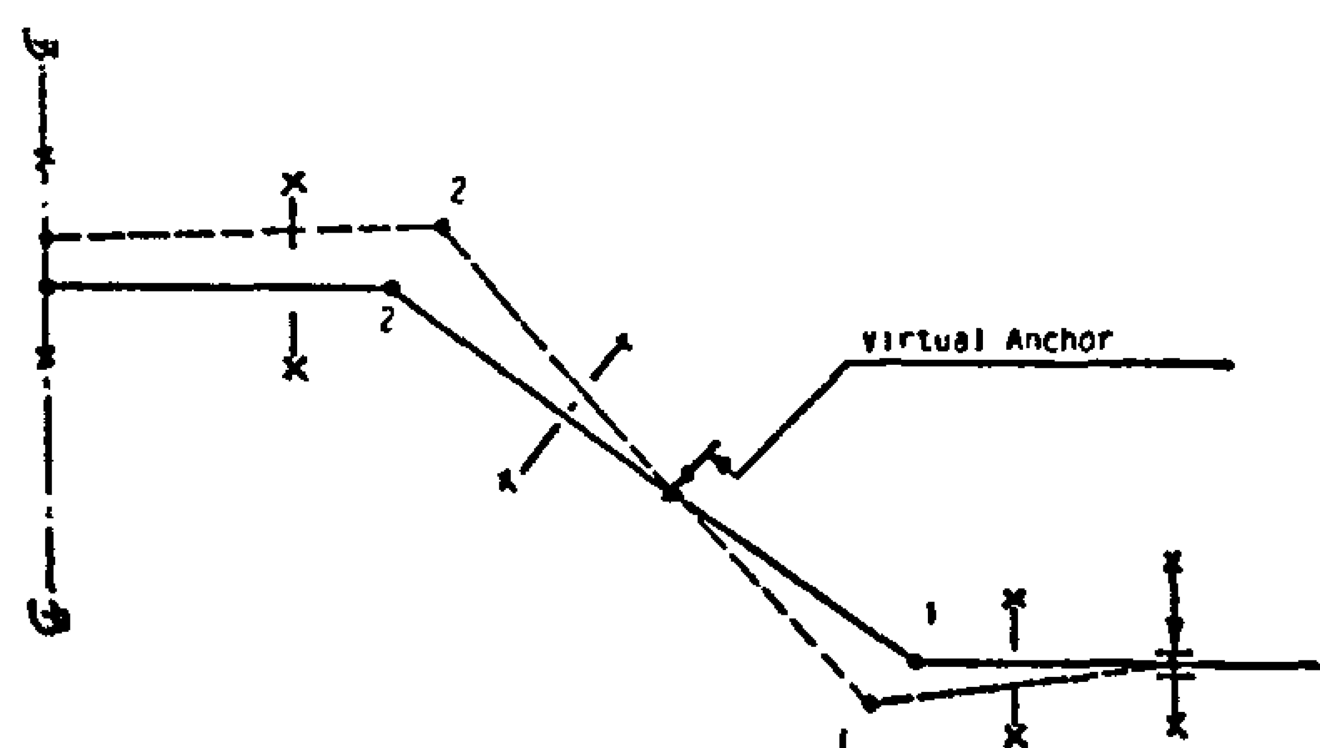


Fig 5 b) Deflected Shape of Production Lines

With regard to steam piping, due to the high pressure of the system, the piping schedule was large. In this project the schedule ranged between large and X-large. Hence, the expansion force was too large at the design temperature, the expansion forces overcame the friction resistance. Therefore, the system behaved as a conventional expansion loop. However, at moderate temperatures (e.g. heating up the system, strat up of the system etc.). A virtual anchor forms at some point along the span of the loop. This anchor causes the pipe to deform in a direction opposite to that expected by conventional loops. Considering the lay out of the two piping systems, this causes collision between the two sets of piping causing damage to thermal insulation and perhaps loss of steam system

dictated by the size of the loop needed to accomodate the expansion of the steam piping.

The design of the trunk lines system went through two phases. The first was composed of a preleminary economical design in which it was concluded that the span of the expansion loop should be in the order of 200 to 300 meters. A preleminary expansion analysis [1] was performed and sizes of the loops were chosen. A summary of this design is shown in table 1.0.

Table 1. Preleminary Design of Expansion Loops.

Pipe size	L (ft)	h (ft)	b (ft)
12	1100	46	40
10	1100-800	16	40
8	1100-800	40	40
6	1100-800	30	40

The second phase comprised computer numerical analysis of the piping system taking into consideration frictional forces.

NUMERICL MODEL :

The piping system was divided into several independent expansion loops. Each loop is surrounded by two anchors. The locations of these anchors were determined on the basis of piping expansion. However, end anchors were determined on the basis of expansion thrust force acting on the pipe supports.

Typical loops were analyzed using "PIPANL" (3). Commercial sofware in North America was reviewed among which it was found out that PIPANL is the most appropriate for modelling friction. The numerical model is based on a 2 dimentional analysis with a model for friction. The solution of equilibrium equations is based on an incremental iterative procedure, "Newton-Raphson'. The pipes are assumed of a linear elastic material. Friction forces are of constant magnitude as shown in euqation (1). However. their directions are opposite to the pipes movement. Limit stops were also used to model the effect of pipe guides, Fig. 3, The limit stop is a support which does not become active until displacements exceed a certain limit. The non-linear F.E. analysis was needed to model these two parameters. Temperature rise was applied incrementally. The pipes segments were modelled by beam elements. A typical F.E. mesh is shown in Fig. 4. A list of the pipe sizes analyzed is shown in table 2.

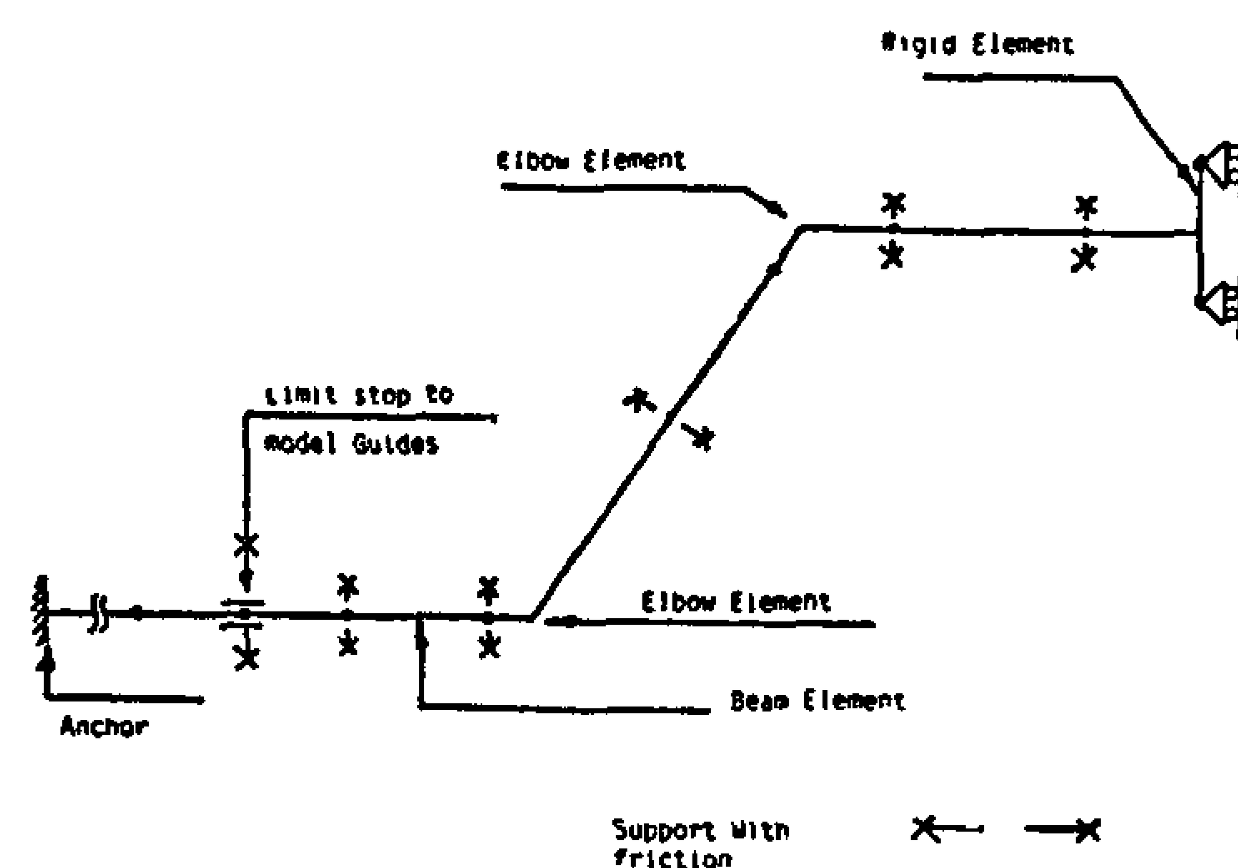


Fig. 4. F.E. Discritization of ½ An Expansion Loop.

DISCUSSION OF THE ANALYSIS RESULTS :

Stress analysis of different diameters, table 2, was performed. Expansion loops were modified until all max stresses did not exceed the max allowable stresses as per the B 31.3 requirements.

Frictional forces had significant effect on the response of production lines. Due to the low pressure of these lines, the pipe thickness and consequently inertia were very low, hence the expansion forces were also small. However, due to the large weight of the piping (including crude oil) friction forces were so large that a virtual anchor occurred at some location intermediate of the 45° degree leg of the loop, Fig. 5.b. This virtual anchor caused the pipe to deform in a man-

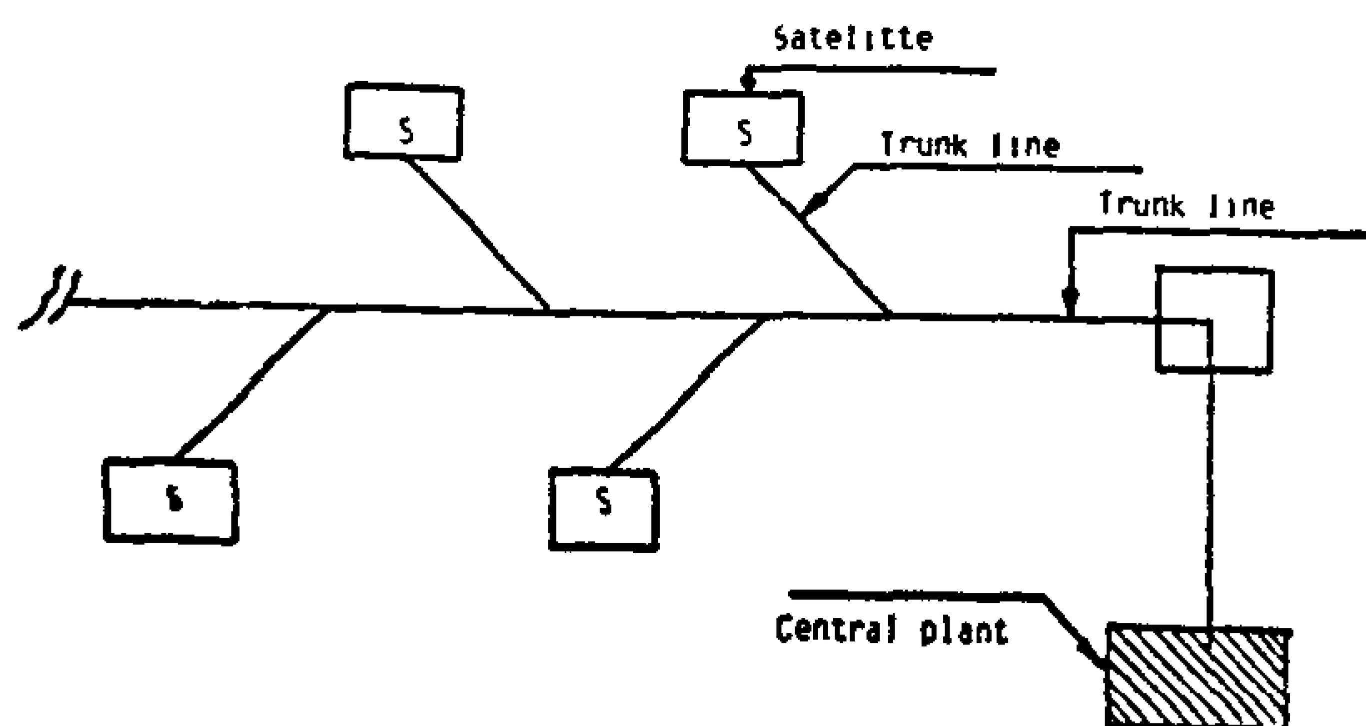


Fig 1 a) Lay-out of the plant

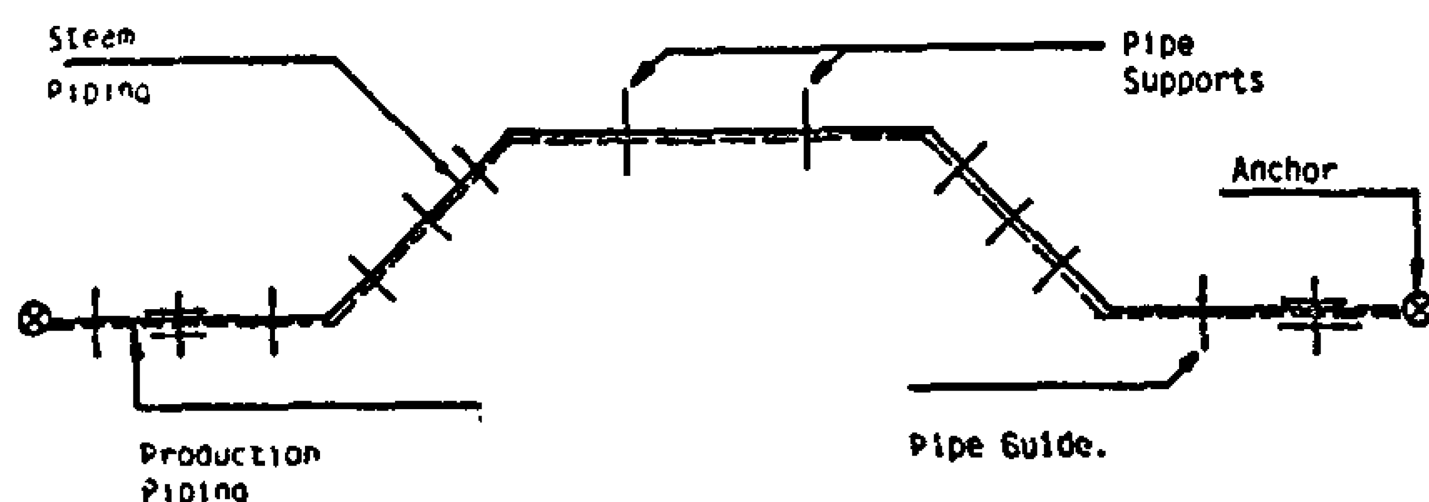


Fig 1.b) Layout of a Typical Expansion Loop

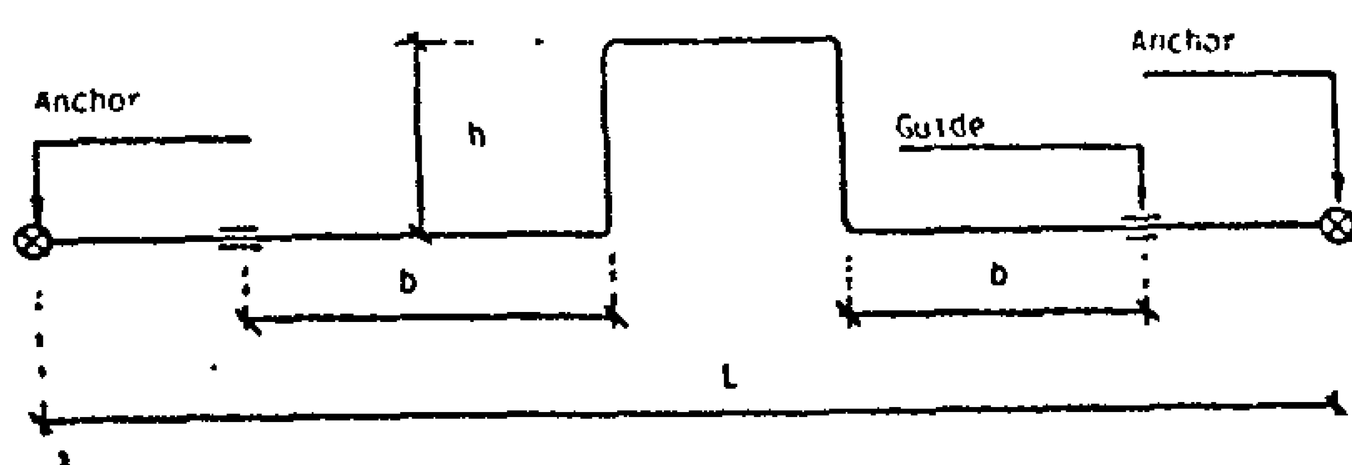


Fig. 2.a) Lay-out of a Conventional Loop

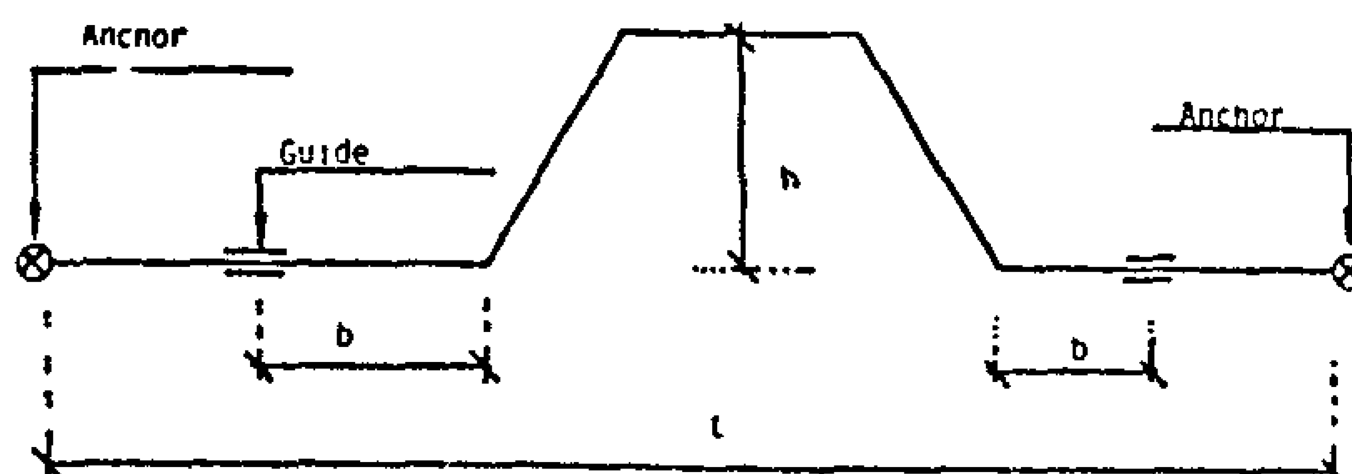


Fig. 2.b) Lay-out of a Non-Conventional Loop

1. Production lines may be designed according to ANSI B 31.3 (7). However, friction forces acting on the piping system should be taken into consideration.

2. Steam piping may be designed to ANSI B 31.1 (6) or B 31.3 (7). Steam piping post the boilers shut off valves does fall primarly under the jurdisdiction of ANSI B 31.1. Therefore, for economical considerations, it was concluded that steam trunk lines may be designed according to B 31.3 (7). Similar to production lines, frictional forces are considered of primary concern. Steam piping of the main plant, however, is designed to B 31.1 (6).

3. Frictional forces are generated out of two sources, namely (Fig. 3.0).

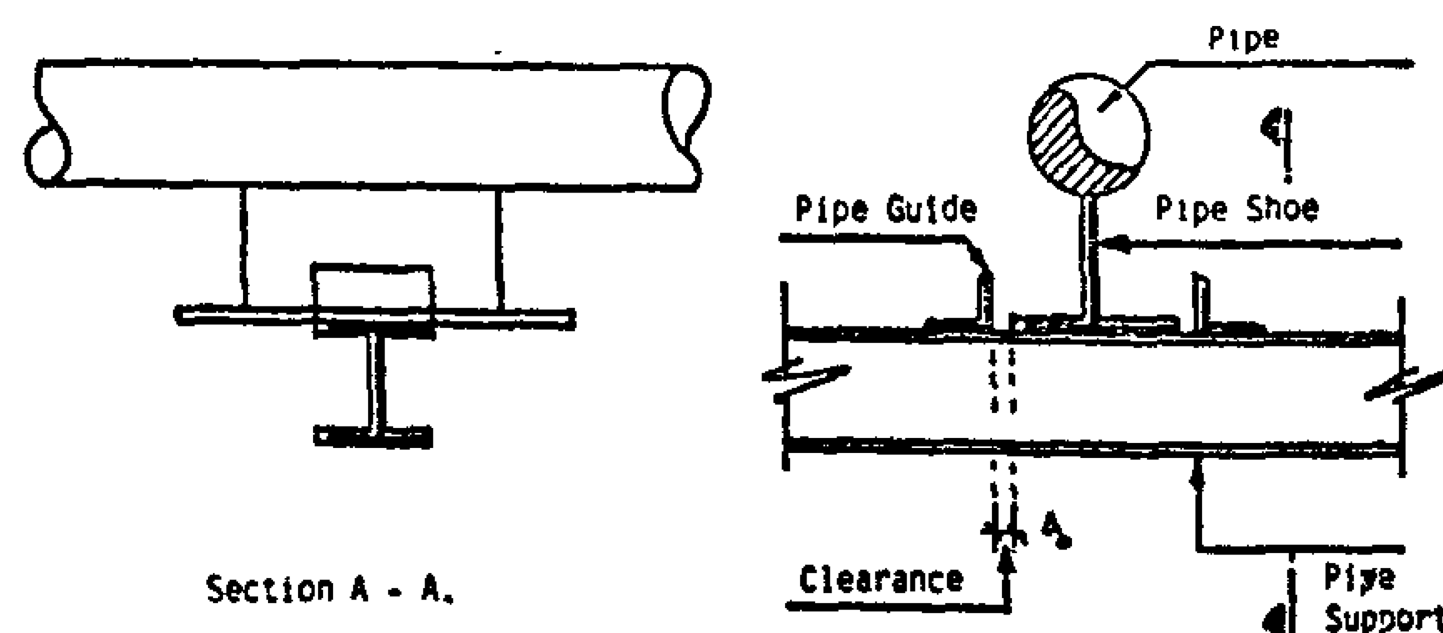


Fig. 3.a) Details of Supporting the Piping System.

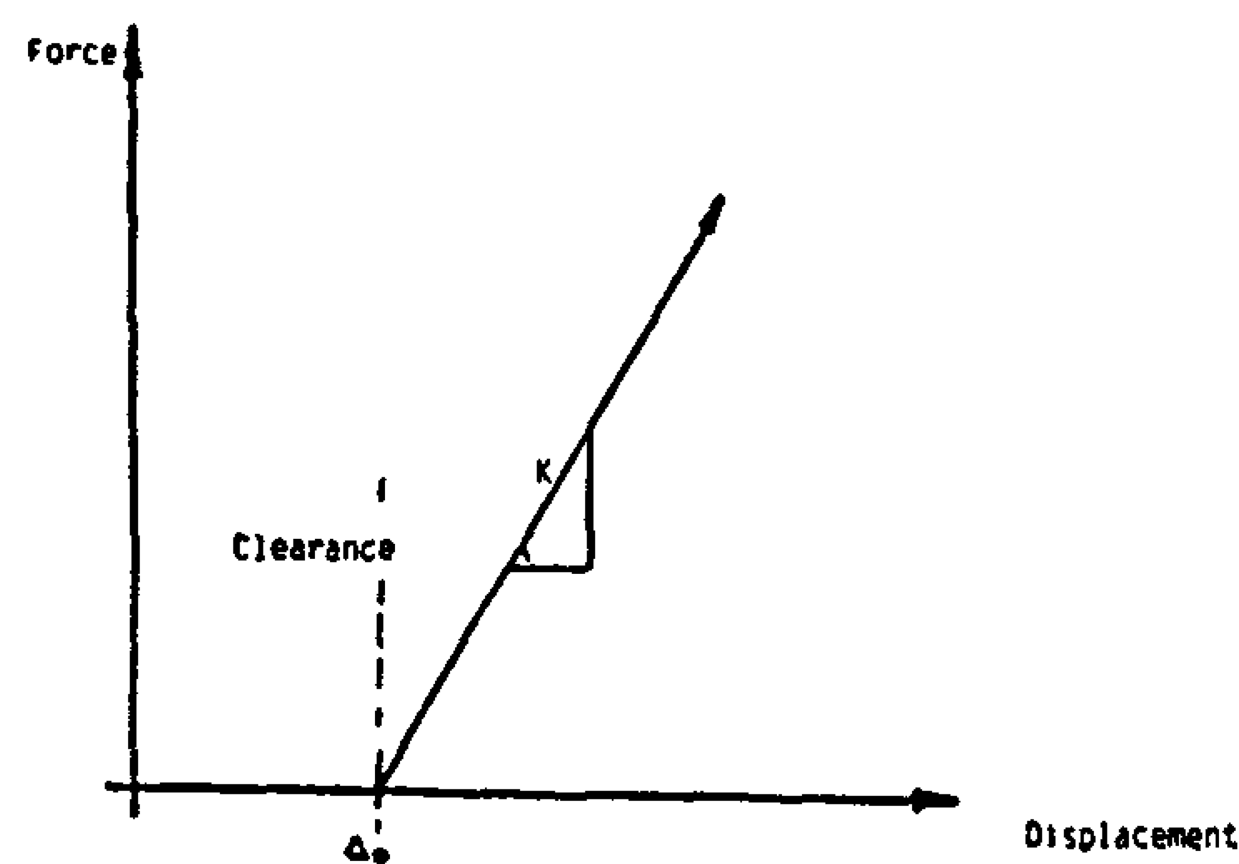


Fig 3.b) Behavioral Model of Limit Stop

a) Contact between the pipe shoe and the pipe support. Friction force is proportional to the pipe weight. This friction force may be expressed as follows :

$$F = \mu W \quad (1)$$

b) Contact between, the pipe shoe and the pipe guides. This contact, however, is not generated until horizontal movement of the pipe exceeds the clearance between the shoe and the guides. The magnitude of this friction force may be expressed as follows :

$$F = \mu N \quad (2)$$

4. The layout of the structural supports is dictated by the expansion loops lay out. Since the steam, compared to the production system, experiences higher pressure and higher temperature, its expansion controlls the loop lay out. Consequently, the size of the expansion loops of the production system is bigger than that neded for thermal expansion and is

STRESS ANALYSIS OF TRUNK LINES OF "WOLF LAKE" HEAVY OIL GATHERING PLANT

Dr. A. H. Anis*

INTRODUCTION :

Heavy oil gathering facilities comprises a set of satellites and a main plant. These satellities are connected to the main plant by a piping system for gathering the produced crude. The system is referred to as "Production Lines" system. In facilities where crude is produced by steam injection a network of piping for injecting steam exists. Each network is divided into main piping (i.e., Trunk lines) and secondary piping. Often these trunk lines are of large diameter. The exact sizes of these pipes are determined according to the size of the facility, the amount of crude to be produced, and the number of satellites served by the trunk lines. Due to the nature of the chemical process by which the crude is gathered, the satellites are often well spread such that the trunk lines may be classified as "pipe lines". However, the variations of the terrain are often not enough to accomode the thermal expansion due to the high design temperature of these lines. Hence, expansion loops must be introduced along these lines.

Wolf lake plant is a pilot gathering facility owned by "British Petroleum" of Canada for producing 7000 B.P.D. of processed oil. A typical lay out of the plant is shown in Fig. 1.0. The trunk lines system is composed of a steam injection system at a design temperature of 700 F° and a production gathering system at 400 F°. A comparative economical study, based on a preleminary analysis, was conducted between a conventional expansion loop, Fig. 2.a, and a non-conventional, Z loop, Fig. 2.b, the results favoured using the Z loop. The results demonstrated considerable saving for the same amount of expansion. However, the clients engineering group has pointed out that some damage has occurred in a previous facility due to collision between the steam and production piping. Based on the economical analysis the layout of a typical loop was chosen as shown in Fig. 1.b. The objectives of the stress analysis were, among other traditional considerations, to avoid this collision which was observed in an earlier facility.

DESIGN CRITERIA :

Traditionally, plant's piping is designed to either ANSI B 31.3 (6) or B 31.1 (8) or B 31.8 (9). Trunk lines system falls in between. The piping is too long to be treated as refinery piping in which frictional forces are treated as secondary forces. At the same time, the expansion movement is too big compared to that of common pipe lines. An investigation of relevant piping codes revealed the following.

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